Tactical Alchemy: Heavy Division Tactical Maneuver Planning Guides and the Army's Neglect of the Science of War

A Monograph
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ABSTRACT

Tactical Alchemy: Heavy Division Tactical Maneuver Planning Guides and the Army's Neglect of the Science of War.

In the wake of the Cold War, the U.S. Army increasingly finds its institutional focus shifting away from preparing for sustained mechanized land combat. This trend serves the Army's immediate operational needs and addresses its perceived need to demonstrate relevancy, but it also raises an important question. How can the Army preserve for future use its hard won expertise in combined arms mechanized warfare? The art of these operations is well documented in doctrine, tactics, techniques, and procedures, but the science of time, space, and combat power in heavy division operations is not. In effect, the Army is already lapsing into what J.F.C. Fuller described as "military alchemy," denying the science of war in favor of theorizing on its art. The generation of officers raised during the Cold War and tested in battle in the Gulf is fading away taking with it the Army's practical expertise in the physics of combined arms mechanized warfare. This knowledge is largely unrecorded in doctrine and has long been absent from the core course tactics instruction at the Command and General Staff College. If the Army is to preserve its institutional expertise in mechanized warfare, it must undertake to document, analyze, and codify this missing science. Failure to do so would place the Army at risk of being dangerously unprepared for the challenges posed by close combat with peer and near-peer competitors in the new century.

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CHAPTER ONE

INTRODUCTION

> To deny a science of war and then to theorize on war as an art is pure military alchemy, a process of reasoning which for thousands of years has blinded the soldier to the realities of war, and will continue to blind him until he creates a science of war upon which to base his art.
> J.F.C. Fuller[1]

Less than two decades into the new century the United States Army found itself fighting a new kind of war, one that it had little practical experience in. A generation of officers raised in the conduct of small unit expeditionary stability and support operations suddenly found itself commanding large units in high-intensity offensive and defensive operations in a major theater of war. Late in the war, a fresh U.S. Army division operating as a part of a combined corps conducted a deliberate attack to seize a river crossing. On the second day of the attack, the division's advance reached the river and gained a toehold on the far shore. That afternoon, the division commander pondered the commitment of his reserve to expand the bridgehead. Apparently concerned by the enemy artillery fires falling on the crossing area, the commander intended to slip the reserve into position across the river under the cover of darkness that night. In the staff's assessment, there was sufficient time; they had calculated that the reserve needed seven and a half hours to complete its movement. Despite little warning, the reserve moved promptly after receiving its orders, but its advance soon slowed to a crawl under enemy harassing fire. As dawn approached, the reserve's lead battalion was still at least an hour from the crossing site. Evidently fearing a daylight crossing under enemy observation and fires, the reserve's commander halted the advance and ordered it into a hasty defense short of the crossing. Recognizing that the division's attack had culminated short of the

objective, the corps commander ordered an allied division to relieve the American unit and continue the attack in its place.[2]

In the case discussed above, the staff of the 91st Infantry Division contributed to the failure of its attack near Audenarde, Belgium on 2 November 1918.[3] At a critical decision point when the commanding general was pondering the use of his reserve, the staff resorted to tactical alchemy. In the absence of relevant planning factors rooted in recent and historical experience in comparable situations, the staff could only offer the commander an inadequate and unscientific assessment of the feasibility of his plan. The staff's calculations were flawed because they had used a simple night road rate of foot movement and had failed to account for the effects of enemy resistance, for the time required to change formations, and for the time needed to execute troop leading procedures.

One cannot easily dismiss this failure because it was symptomatic of a larger problem that resonates even today. While the 91st Division was a National Army division composed of draftees, it had its share of Regular officers including a commander who had risen from the enlisted ranks. While not yet a veteran unit, it had fought for five weeks previously during the Meuse-Argonne offensive.[4] Indeed, the staff's problem understanding the science of time and space in division operations was typical of the experience of American units during World War I. Referring specifically to the American Expeditionary Force (AEF) COL George C. Marshall later observed "accounts of the World War bristle with tactical failures that are directly due to fallacious conceptions of time and space."[5]

It is surprising that this was the case. Contemporaries and historians alike have heaped praise upon the graduates of the U.S. Army Command and General Staff College (CGSC) who filled the key staff positions and bore the weight of the planning in the AEF during the war.[6] What made these "Leavenworth men" so critical to the success of the AEF was their grasp of large unit operations, their knowledge of doctrine, and their skill

in staff procedures at a time when these qualities were unusual in the Army. The older generation of officers who led the AEF counted on the graduates of CGSC to understand the physics of war, to be able to transform commanders' decisions in to executable plans.[7] Today, generals still depend on graduates of CGSC for the same reason. Unfortunately, contemporary changes in the institutional focus of the Army give one good reason to doubt whether future graduates will be sufficiently competent in the science of the time, space, and combat power of division operations.

With the notable exception of the Vietnam War the Army has spent much of the twentieth-century honing its skills in combined arms mechanized warfare against a symmetrical enemy. Where the terrain is conducive, combined arms mechanized warfare offers a wealthy and technologically advanced power such as the United States a superb tool that leverages its strengths and offers the prospect of quick and decisive results. However, in the wake of the Cold War and its overwhelming success in the Gulf War, the world's sole military superpower finds its most likely foes unwilling to wage war on these terms. Instead, these states and non-state entities are increasingly turning to asymmetric means and weapons of mass destruction. In response to this trend and the proliferation of ethnic and religious conflicts in the Third World, the President has reoriented the national military strategy toward engagement and preemptive deployments to limit threats to American interests. Consequently, the Army has spent a decade responding to the demands of comparatively small joint and combined expeditionary stability and support operations, leaving few resources for sustaining its skills in offensive and defensive mechanized warfare.

In the immediate future, this trend is likely to escalate. General Eric K. Shinseki, the U.S. Army's Chief of Staff, has announced his intent to reshape the Army to enhance its responsiveness to the needs of U.S. joint force commanders around the globe. One major thrust of his program is an effort to eliminate the distinction between the Army's lethal but slow to deploy heavy mechanized forces and its more agile, but dramatically

less potent light forces. Shinseki envisions a prototype or medium force that combines the best attributes of traditional heavy and light forces; he would optimize such units for the peace and contingency operations that have occupied the Army for the past decade.[8]

This trend serves the Army's immediate operational needs and addresses its perceived need to demonstrate relevancy, but it also raises an important question. How can the Army preserve its expertise in combined arms mechanized warfare for the division staff officers of the future? Given the capabilities of hostile states such as North Korea and Iraq and the likely emergence of peer competitors in the coming century, this is an important question. Military expertise is a perishable commodity and the Army's practical knowledge of combined arms mechanized warfare is deteriorating. The generation of officers raised during the Cold War and tested in battle in the Gulf is quickly fading into retirement. Their practical knowledge of the physics of heavy division operations is largely unrecorded and much of what exists is already outmoded. While officers quickly acquire an intuitive and experiential understanding of operations below brigade-level, it is much more difficult to grasp the physics of division operations. These operations are exponentially more complex and dependant on high performing and tightly integrated staffs. Even today, the high turnover of division staff officers and infrequent, simulated division maneuvers combine to keep staff officer proficiency at low levels.

The Army's future leaders, the captains and lieutenants patrolling the former-Yugoslavia today, may face an enormous challenge in the future. Like their predecessors in 1917, they will have spent their formative years garnering experience and developing skills in peace operations that have limited application to offensive and defensive mechanized warfare, especially at the division and higher levels. Unless there are substantial changes, neither Army doctrine nor CGSC will help them grasp the physics of such operations. For the young officers in the Reserve Component —where much of the residual heavy force will likely reside — this deficiency may be insurmountable. It is

imperative that the Army act soon to preserve its institutional knowledge in these types of operations so that it will be available in the future.

One can usefully divide this body of knowledge that the Army must conserve into the broad categories of art and science. An art is the conscious use of skill in a creative, goal-oriented activity.[9] The military art of mechanized warfare answers the question how. It is the inventive process of employing mechanized forces to accomplish tasks at the level of war appropriate to those formations. Science, on the other hand, involves the systematic analysis of observable facts with an aim to distilling general truths or laws with broader application.[10] Military science defines the realm of the possible in mechanized warfare. It involves understanding the physics, the relevant observable facts that determine if the military artist's creative vision for accomplishing a task can be transformed into an executable plan.[11]

The physics of military operations have three aspects: temporal, spatial, and relative combat power factors. Temporal factors address the consumption of time on the battlefield. Pass time is a good example of a temporal factor. Commanders and staff must know how long it their unit will require to pass any single point when moving on a given number of routes. Second, spatial factors relate to the battlespace requirements associated with units and tactical tasks. For example, an artillery battalion needs an area of certain dimensions to fire and evade counterbattery fires. The third aspect of the science of war is relative combat power. These factors enable commanders and staffs to assess the quantifiable aspects of unit combat power and array units with reasonable expectation that they will be able to accomplish their assigned tasks. As an illustration, experience shows that to have at least a fifty-percent chance of penetrating an enemy defense an attacker requires a specific force ratio at the point of penetration.

How then should the Army preserve for future use its knowledge of heavy division offensive and defensive operations? The Army has already documented the art of combined arms mechanized warfare in its doctrine, tactics, techniques, and procedures.

As the pages that follow will show, the challenge of recording its science remains largely unanswered. They will explore in more detail the extant doctrine related to the science of heavy division operations, military science and history in the American tradition, and the tactics curriculum of CGSC since 1976. They will also to contrast the American approach to these topics with the dramatically different example of the former Soviet Union.

After completing this review, it is clear that it would be profitable to document the science of heavy division operations in the form of more comprehensive and authoritative staff planning guides. Such guides could be both a reservoir of practical expertise and the critical planning tool that helps staffs define the realm of the tactically possible. Incorporating such guides into tactics instruction at CGSC would ensure that division staff officers throughout the Army are capable of producing executable orders. Codifying the temporal, spatial, and relative combat power planning factors for offensive and defensive mechanized operations would also reinforce the criticality of the physics of stability and support operations as well. Finally, this process would also move the Army beyond the military alchemy that has dominated the American approach to war for much of its history.

ENDNOTES

[1] Col. J.F.C. Fuller, *The Foundations of the Science of War*, Reprinted by the U.S. Army Command and General Staff College Press, Fort Leavenworth, KS 1993 ed. (London: Hutchinson & Co., 1926), 21.
[2] COL George C. Marshall, *Infantry in Battle*, Second ed. (Washington, D.C.: The Infantry Journal, Incorporated, 1939), 86-88 and American Battle Monument Commission, *American Armies and Battlefields in Europe* (Washington, D.C.: United States Government Printing Office, 1938), 395-397.
[3] Ibid.
[4] Edward M. Coffman, *The War To End All Wars: The American Military Experience in World War I* (New York: Oxford University Press, 1968), 305-306.
[5] Marshall, 92.
[6] Coffman, *The War To End All War*, 264-265 and Carol Reardon, *Soldiers and Scholars: The U.S. Army and the Uses of Military History, 1865-1920*, ed. Theodore A. Wilson, *Modern War Studies* (Lawrence: University Press of Kansas, 1990), 201.
[7] Edward M. Coffman, "The American Military Generation Gap in World War I: The Leavenworth Clique in the AEF," in *Command and Commanders in Modern Warfare: Proceedings of the Second Military History Symposium, U.S. Air Force Academy*, ed. William E. Geffen (Washington, D.C.: US Government Printing Office, 1969), 38-39, 40.

[8] General Eric K. Shinseki, Chief of Staff, U.S. Army, *Address to the Eisenhower Luncheon, 45th Annual Meeting of the Association of the United States Army, October 12th, 1999* ([cited 15 October 1999]); available from http://www.hqda.army.mil/ocsa/991012.htm and General Eric K. Shinseki, "Intent of the Chief-of-Staff, Army," (1999).

[9] Adapted from James J. Schneider, *Theoretical Paper No. 3: The Theory of Operational Art*, 2d Revision ed. (Fort Leavenworth, KS: School for Advanced Military Studies, U.S. Army Command and General Staff College, 1988), 2 and *Webster's New Collegiate Dictionary*, (Springfield, MA: G.& C. Merriam Company, 1979), 63.

[10] Schneider, *Theoretical Paper No. 3*, 3 and *Webster's*, 1034.

[11] The interrelationship of the art and science has a rich literature. One of the best concise explanations in English comes from COL Huba Wass de Czege's "How to Change an Army," *Military Review*, November 1984, 32-49. Wass de Czege writes, "Modern military endeavor consists of both science and art. There is no question that it is both. Military science consists of the systematized knowledge derived from observation, study and experimentation carried on to determine the nature, principles, means, methods and conditions which affect the preparation for or conduct of war. The art of war is the application of this knowledge to a given situation...." 38.

CHAPTER TWO

THE SCIENCE OF HEAVY DIVISION OPERATIONS IN CONTEMPORARY U.S. ARMY DOCTRINE

The U.S. Army is notorious for failing to apply lessons learned.

Department of the Army Ad Hoc Committee
on the Army Need for Study of Military History, 1971[1]

Before proceeding any further, it is critical to examine current Army doctrine to establish what it offers heavy division planners looking for help with the science of war. Implicit in that task is a brief review of the Army's historical conceptions of military doctrine, history, and science. This process will establish the context for a detailed examination of the CGSC tactics curriculum that will further amplify the dimensions of the challenge of perserving and documenting the science of division offensive and defensive operations in mechanized warfare.

The Extant Doctrine

When today's division staff officers look for the science of division operations what does doctrine provide them? The answer is not much. Most doctrine merely raises issues associated with time, space, and combat power without providing much guidance as to how to apply them.

FM 101-5 Staff Organization and Operations is the first place many officers turn when they begin executing the Military Decision-Making Process (MDMP). During mission analysis, this doctrine tells the staff that it must review the forces available to determine if they are sufficient for the tactical tasks that the higher headquarters has assigned their unit. Yet, the authors provide no suggestions about how the staff is to

perform this troop to task analysis.[2] When it comes time to array forces as a part of course of action development, *FM 101-5* suggests the general procedure of comparing the raw numbers of units two levels down. At the division level, this translates to comparing the number of maneuver battalions available to both sides. This form of relative combat power analysis is absurdly crude. Few officers will find any value in a methodology that equates units of obviously different levels of combat power. A fresh M1A2 tank battalion, for example, clearly has more combat power in a desert environment than an attrited light infantry battalion. Still, *FM 101-5* warns the staff of the dangers inherent in applying unspecified quantitative planning factors in the process, saying,

> Planners must not develop and recommend COAs based solely on mathematical analyses of force ratios. Although some numerical relationships are used in this process, the estimate is largely subjective.... Numerical force ratios do not include the human factors of warfare that, many times, are more important than the number of tanks or tubes of artillery.[3]

As suggested in the preceding passage, another obvious flaw of relative combat power analysis as described in FM 101-5 is that it fails to make any useful allowance for intangible elements of combat power such as leadership, morale, and training. The doctrine instructs staff officers that they "must carefully consider and integrate [these] intangible factors into their comparisons," but fails to give them any instructions for how to go about this.[4] Finally, the authors suggest that by using unspecified, "historical minimum-planning ratios for various combat missions," the staff should arrive at a measure of the feasibility of the various potential courses of action.[5]

The second and most logical place to look for the science of heavy division operations is in *FM 71-100 Division Operations.* This manual's discussion of spatial factors is wholly inadequate. For example, it provides no usable guidance about the size of the area in which one can expect a division to operate. It simply asserts that those dimensions are dependant on the mission, enemy, time, terrain and troops available (METT-T). [6] Without a doubt, the factors of METT-T should influence the size of a

division's area of operations — its frontage and tactical depth —but such blanket statements leave the entire burden of assessing these factors on the shoulders of the staff. Most division staff officers are recent CGSC graduates with considerable experience in the operations of brigades and battalions. Their expertise in the science of war at that level does not readily translate to division operations because of the exponentially greater complexity of that unit's operations. In the absence of doctrinal tools to aid them in calculating the spatial requirements of the division or its subordinate units, *FM 71-100* leaves staff officers to their own and likely inadequate devices.

FM 71-100 is more directive about the temporal and spatial factors that influence division march planning. It furnishes a few vague rules of thumb without providing the context necessary for the staff to understand and apply these rules to their own peculiar situation. The manual states:

> For tactical movement, planners must understand the size of units and the related time and space factors for most movement operations.... They should know the time it takes the division to pass on multiple routes at a designated speed (a division will normally move on at least four routes), general pass times, column lengths....[7]

Without explanation, *FM 71-100* suggests that the division's maneuver brigades should normally march on multiple routes with their subordinate battalions each in column on a single route. The authors explain neither the rationale for this assertion nor any of the other options available to the division and their relative merits. They do provide some rules of thumb for planning the division's deployment as it reaches the line of departure for an attack. The manual asserts without amplification that both battalions and brigades require at least two routes and "as a rule, the time allowed for [battalion] deployment should not be less than the pass time of the leading companies....[8]" The only other temporal planning factor mentioned in *FM 71-100* is that a division should expect twenty-four to forty-eight hours notice before commitment to a deliberate attack.[9] It offers no reason why this should be the normal case and fails to explore any of the

implications of any deviation from this rule. Finally, *FM 71-100* furnishes its readers absolutely no guidance on how to assess relative combat power in the context of division operations.

If the basic doctrine for division operations is so inadequate where else can a staff officer turn to find the science of these operations? Unbelievably, there is no published tactics, techniques, and procedures (TTPs) manual for the heavy division! The closest thing available is *FM 71-100-2*, a TTP manual which only addresses the light divisions. Unfortunately, this manual suffers from the same lack of specificity and detail that characterizes the discussion of the science of war in *FM 71-100*. It is indicative of the Army's lack of concern for the science of war that it currently has no plans to publish a TTP manual for the heavy division.[10] A search of the Center for Army Lessons Learned database — another potential source of TTPs for division operations — reveals nothing of value. This suggests both the limitations of the Army's current system for collecting and making available "lessons learned" and the frustration latent in the current state of the Information Revolution.[11]

The best source of tactical planning factors currently available is an appendix to *FM 34-130 Intelligence Preparation of the Battlefield.* [12] Indeed, the authors of *FM 101-5* refer their readers to this manual for planning factors.[13] The appendix begins by warning readers in the dramatic fashion of Figure 2-1.

> CAUTION: These figures should be used as a last resort, and only when better and more timely information will not be available.

Figure 2-1 Warning to Users of Appendix B of FM 34-130.[14]

It is symptomatic of the state of the science of war in the Army that the authors of FM 34-130 felt it necessary to label the only set of doctrinal planning factors a tool of last resort so prominently! Lest readers miss the point, the authors attribute the Fall of France

in 1940 and various other historical military disasters to the misuse of rules of thumb such as these. Two more paragraphs follow to amplify this cautionary tone.[15] The pages that ensue contain a mixture of charts and tables, which provide a variety of planning guides. These range from the tactical obstacle-crossing capabilities of individual systems to the "historical" force ratios required for typical missions. (See Appendix A) While impressive on the surface, a detailed examination of these guidelines reveals their limitations. Much of the data provided is either dated or incomplete. Even in 1994, when the Army published *FM 34-130* few planners were concerned with factors related to M60 series tanks, jeeps, and Division 86 unit organizations. Similarly, division planners have little use for charts that help them determine the wind chill or how far a naked eye can see on a clear day. Finally, the authors' failure to provide any information about the sources and methods used to create their planning factors limits their relevance and utility at the division level.

The wealth of planning factors available to a division's other planners stands in stark contrast to what maneuver planners have access to. Over the years, Army logisticians in particular have accumulated a vast collection of data on the sustainment of division operations in a variety of tactical and geographic settings. Consider the example of *FM 101-10-1 Staff Officer's Field Manual Organizational, Technical, and Logistical Data Planning Factors.* It is a massive multi-volume reference work for calculating logistical requirements such as fuel consumption, ration requirements, and equipment loss rates.[16] With the exception of extracts published in *CGSC Student Text 101-6 G1/G4 Battle Book*, the Army no longer updates this manual in print, but maintains the data set within the software used by logistics staff officers.[17] Military intelligence, chemical, engineer, artillery, and other combat support officers on division staffs have access to similar planning factors in the doctrine of their branches.[18]

As seen above, today's division staff officers have access to very little useful information about the science of heavy division maneuver. The extant doctrine for the

Military Decision-Making Process and division operations, as well as the manuals that support it, provides scarce and inadequately explained planning guidelines. This leaves maneuver staff officers dependent on their own intuition, experience, and individually produced "battle books." If the Army is to carry forward a usable science of heavy division offensive and defensive maneuver into the twenty-first-century, it will have to do much more.

Military History and Doctrine in the American Military Tradition

> The study of military history yields certain consistent truths about combat which modern operations planners ignore at their peril.
>
> COL Trevor Dupuy[19]

> Scattered throughout history, we can see the wreckage of armies that learned nothing from their experiences or learned badly, or learned too late.
>
> Roger J. Spiller[20]

If the Army is to reclaim its expertise in the science of mechanized warfare, it must do so within the context of the American military tradition. It must consider the Army's propositions on both military history and doctrine over time. Such notions are particularly important because attitudes towards history and doctrine affect the ways in which officers interpret and apply relevant experience.

Concerning military history, traditionally American soldiers and the Army as an institution have recognized four distinct functions for this field of study. As an aid to building cohesion, the Army encourages soldiers to know and study the histories of their units, branches, and the Army as a whole. Second, the Army uses history as a tool to justify actions and budgets both within the institution and to the public, lawmakers, and policymakers. While these first two uses do not bear on this study, the Army's use of

military history in the development of doctrine and officer education is more pertinent. With varying degrees of emphasis throughout its history, the Army encouraged and at times required officers to use military history as a laboratory for testing and applying axioms, principles of war, and other deductions. Even in the Golden Age of this "applicatory method" during the early years of CGSC, the Army's use of history as laboratory was far less scientific than it sounds. It amounted to using the study of campaigns and battles to illustrate a handful of principles of war. As Carol Reardon, the leading scholar of this subject, argues, the function of such instruction was to ensure "safe leadership." This was a shared understanding of the vocabulary, procedures, and broadest principles of military practice among the graduates of CGSC. [21] It also connoted a minimum standard of tactical competence. As the author will show later, since 1976 CGSC has largely failed to meet this challenge with regard to the science of heavy maneuver.

After World War II, officer education focused on managerial skills and the role and prominence of military history suffered consequently.[22] The Army's view of the utility of its history reached its nadir late in the Vietnam War. As the Army's leaders searched for solutions to the terrible state of the Army in the early 1970s, they turned to military history for help. In 1971, the Army established the Ad Hoc Committee on the Army Need for the Study of Military History. The authorizing directive for this committee noted that the Army had "moved away from its traditional reliance upon the experience of history."[23] The Committee's report suggested the Army revitalize and coordinate the use of history in officer education.[24]

One of the fruits of that effort was *A Guide to the Study and Use of Military History* published in 1979. While not bearing the imprimatur of doctrine, this handbook represented the Army's best available thought on the role of military history in officer professional development. It was very widely distributed within the officer corps, with newly commissioned officers receiving it at their branches' officer basic courses. Some

of the guide's specific observations bear quoting. One consistent theme of the guide is the ability of military history to provide vicarious experience to compensate for deficiencies in that area.[25] Without specifically mentioning military science, one of the authors stressed the value of military history in staff work, warning that "the officer who is poorly grounded in military history will often operate at a disadvantage in the staff arena."[26] The authors pointed out that history could be used to assist advances in the military art but they were also careful to warn readers against attempts to wean immutable rules from history.[27]

Another outcome of the Ad Hoc Study was *Army Regulation 870-5*, which establishes the parameters of the Army's military history activities. In its most recent revision, the Army tasks the Center of Military History (CMH) in Washington, D.C. to provide historical works to support decision-making and doctrinal development.[28] It directs the Combat Studies Institute (CSI) at Fort Leavenworth — another product of the Ad Hoc Study — to research topics pertinent to doctrinal concerns and publish the results.[29] The regulation requires the Army's major commands to include military history in leader development and to use it as an aide to decision-making.[30] It assigns the Army Historical Program the mission to "preserve, critically interpret" among other tasks. Finally, *AR 870-5* sanctions the use of military history to preserve institutional memory and support decision-making.[31] Overall, the Army's view of military history seems prepared to support an attempt to preserve the science of mechanized maneuver at the division level. However to do so, the Army Historical Program and the role of military history in officer education will require some modification.

Perhaps more than military history, how the Army views doctrine will have a powerful effect on how it approaches preserving its skill in combined arms mechanized warfare. One must understand what the Army means by doctrine before explaining how that construction has changed over time. Only then can one begin to imagine its likely influence on efforts to document the military science of heavy division operations. *Joint*

Publication 1-02 defines doctrine as "fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgement in application."[32] In the pages of *FM 100-5,* the Army defines doctrine as an authoritative statement of how the Army intends to fight. In doing so, it "must be definitive enough to guide specific operations, yet remain adaptable enough to address diverse and varied situations worldwide." In consonance with the idea of Safe Leadership, Army doctrine also "facilitates communications... establishes a shared professional culture and approach to operations" and is the basis of all training and education.[33]

With its emphasis on doctrine's authoritative nature, this view is a relatively recent departure from a long tradition of loose doctrine. For most of its history, Army doctrine meant drill manuals that made no broad statements about the conduct of future land war. [34] The Army's first "doctrine" was Friedrich Wihelm von Steuben's *Regulations for the Order and Discipline of the Troops of the United States*, a drill book used at Valley Forge.[35] A succession of arm specific drill manuals followed until 1891. In that year, Fort Leavenworth published tactical manuals for the infantry, artillery, and cavalry arms. Only then did the Army acquire official documents describing the way American troops would be organized and fight as units.[36]

In the first half of the twentieth-century, the Army slowly moved towards an authoritative unifying doctrine. The Root Reforms at the turn of the century aided this process by creating a general staff and the Army's service schools. Shortly thereafter, the War Department published the first umbrella statement of doctrine, the 1905 — and original — *Field Service Regulations* (FSR).[37] Between the World Wars, the body of Army doctrine moved closer to its modern construction. In 1930, the Army published its first doctrine for the operations of corps and armies. This *Manual for Commanders of Large Units (Provisional), Vol. I, Operations* was followed in 1939 by the first FSR to be labeled *FM 100-5, Operations*.[38]

Doctrine remained in the background of Army affairs for much of the century because it lacked institutional support. Until well after World War II, anonymous staff officer committees in the Army's disparate schools wrote doctrine. Since such writings were not authoritative, the Army neither integrated doctrine with weapons development nor held commanders in the field accountable for adhering to it. [39] Even after World War II, an individual officer's professional judgement held higher authority than official doctrine in almost any matter. The widespread application of systems analysis within the Department of Defense during the Cold War, especially during Robert A. McNamara's tenure as the Secretary of Defense made the Army's reliance on mere professional judgement seem antiquated.[40] As an example of how wide the gap between doctrine and practice was in the mid-century Army, one need look no further than World War II tank destroyer doctrine.[41]

In the 1970s, events and personalities converged to revolutionize the Army's approach to doctrine. The end of the Vietnam War, the 1973 Arab-Israeli War, and the concurrent establishment of the Training and Doctrine Command (TRADOC) created a set of circumstances pregnant with the possibility for substantive change in both the content and meaning of Army doctrine. Even as the Army turned inward in the wake of its failures in Southeast Asia, it came to recognize how poorly prepared it was to fight the Soviets in Europe. Doctrine provided a vehicle for addressing this problem in swift and decisive fashion. Under the leadership of General William E. DePuy, TRADOC got the Army's senior leaders personally involved in the drafting of the 1976 edition of *FM 100-5*.[42] Through this document, DePuy imposed his conception of doctrine on the Army as a whole.[43] In the words of a leading student of this transformation, doctrine now became the "overarching concept of warfare that would rationalize everything the Army did...."[44] By foisting dubious tactical ideas upon the force, DePuy also unintentionally initiated a renaissance in professional discourse on doctrine across the Army.[45] While the Army quickly discarded the content of the 1976 *FM 100-5*, it has since wholeheartedly

embraced the idea of an authoritative, integrated doctrine. This perspective on how doctrine has mutated since Vietnam gives those who advocate changes in the American concept of military science reason to hope.

Military Science in the American Military Experience

> In the decades since the McNamara Revolution in the Pentagon, quantitative analysis and professional military judgement have often been treated as opposite poles in a two-dimensional world. Quantitative analysis has been depicted as objective, scientifically sound and reproducible by anyone skilled in the art; military judgement as highly subjective, based primarily on experience and peculiar to the official offering it.
>
> Anonymous[46]

The United States has a long tradition of taking an intuitive nonscientific approach to war. As our current doctrine shows, even the Army itself prefers to think of war as an art and not a science. Officers learn to rely upon their own experience and perhaps innate genius to guide them in almost every circumstance.[47] In the American tradition, such attitudes reflect a disdain for military professionalism rooted in the Founding Fathers' fear of standing armies as a tool of tyranny hostile to both democracy and individual liberty. This fear and a desire for economy has led the nation to insist on a small Army in peace. The outbreak of war has traditionally brought about the mobilization of a force composed largely of short-term volunteers and conscripts. Rarely have there been enough Regular Army officers to meet the demands of this huge force, so modestly trained civilians have filled the gap. In the twentieth-century, our reliance on wartime mobilization has also caused American military science to focus largely on the mechanics of building, transporting, and sustaining large armies overseas. If the Army is to succeed in documenting the science of combined arms mechanized warfare, it must begin by confronting these attitudes within the force itself.

Throughout its history, Army officers have grappled with the relationship between art and science in war. The notion of a distinct art and science of war played an important part in the development of officer professionalism in the Army in the late nineteenth-century.[48] Many contemporary officers such as Major General John M. Schofield recognized that the two were inseparable. In 1877, while the Superintendent at United States Military Academy, Schofield warned officers, "it is the *Science* of War, in the broadest sense, not simply the *Art* of War, that we are to study." In the same address, he also charged his audience to learn from "the careful study of the experiences of others who have gone before us."[49] Still, until World War I, American officers largely confined their conception of a science of war to the technical aspects of military engineering and artillery gunnery.

Between the World Wars, the development of American military science remained focused largely on either broad truths or branch technicalities. There was widespread interest in "scientific" principles of war grounded in a widely held belief that the Allies had fought the recent war inefficiently.[50] Consequently, the Army laid out the Principles of War for the first time in *War Department Training Regulation No., 10-5* published in 1921.[51] Doctrine writers framed their work in broad concepts and principles, carefully avoiding specific solutions. Powerful voices warned officers to avoid looking for canned answers to the tactical problems they would encounter. No less a figure than George C. Marshall, a colonel of infantry at the time, used his influential inter-war book *Infantry in Battle* to emphasize the uniqueness of every combat situation. He wrote:

> Leaders who think that familiarity with blind rules of thumb will win battles are doomed to disappointment. Those who seek to fight by rote, who memorize an assortment of standard solutions with the idea of applying the most appropriate when confronted with actual combat, walk with disaster.[52]

World War I experience bore other fruit as well. For example, after the war, CGSC included numerous exercises and terrain walks that trained staff officers to plan and

understand the time and distance factors involved in large unit movement.[53] Marshall himself devoted a chapter in *Infantry in Battle* to time and space in tactics. He wrote that "commanders and their staffs must give the most careful thought to the considerations of time and space."[54] He argued that "incorrect estimates of the amount of time required for the distribution of orders, the movement of units to new locations and for the necessary reconnaissance by subordinates, frequently lead to tactical failure." Interestingly, Marshall was critical of the extant march planning tables.[55]

Since World War II, the Army has continued to struggle with its conception of military science. Consider the yawning gap between its Operations Research and Systems Analysis (ORSA) and military history communities. The Army's policy for assigning officers to the ORSA career field (FA49) neither recognizes history as an academic discipline that supports designation into FA49 nor mentions history in the "officer characteristics" required by that specialty.[56] Indeed this is a problem that some have long recognized. In 1970, Robert McQuie made the trenchant observation that "neither Army operations research nor military history makes much use of the other."[57] Other critics have cited the high cost the Army pays for tolerating this long-standing problem. In 1984, one anonymous author lamented in *Army* magazine that the military had become far too accepting of ahistorical quantitative analysis methods. He argued "we ... have come to accept to many [studies] without subjecting them adequately to comparisons with historical experience or common sense."[58] The author also criticized the Army's failure to exploit the potential of quantitative tools to support commanders and staffs in the field. In the absence of such tools, he wrote, "we must rely primarily on intuition and the 'feeling' of the situation, coupled with a hope that we can muddle through if things get tight."[59] In that author's assessment, this situation could only be the result of either oversight or disdain for the systematic study of military experience.[60]

To address this problem, McQuie and others have proposed a concerted effort to mine historical records to produce data for ORSA studies.[61] Colonel Trevor Dupuy and

his private firm, the defunct Historical Evaluation and Research Organization (HERO) were the leading exponents of such an approach. In a number of government funded studies, journal articles, and the book *Numbers, Predictions, and War,* Dupuy and his allies have struggled in vain to produce a usable database of military historical experience. In the introduction to the latter, John R. Brinkerhoff, a veteran Department of Defense ORSA, described it as "the first systematic attempt to apply modern operations research methods to large masses of historical combat data."[62] For his part, Dupuy asserted the book's purpose, writing that:

> Presumably if we can collect enough reliable data from military history we should be able to determine patterns of conduct performance and outcomes that will provide basic insights into the nature of conflict, and that will indicate trends to assist military planning for the future.[63]

Despite Dupuy's good intentions, HERO has yet to realize its goal. No doubt, one reason has been the strident nature of Dupuy's criticism of the very analysts he is trying to reach. In *Numbers, Predictions, and War,* he was very critical of ORSAs for their less than rigorous approach to the data and relationships that underlies their models of combat. Dupuy condemned the field by suggesting that, "the task of digging out [data] is too great, and the obvious utility of the results too questionable to warrant the effort by busy and impatient analysts; it is easier to guess, to assume, or to generalize."[64] Indeed, the author spends an entire chapter of his book deploring the lack of historical training and historical-mindedness among ORSAs.[65] In another venue, Dupuy echoed this observation writing that "despite widespread lip service to the importance of military history — a large proportion of operations research analysts and decision-makers in the defense establishment tend to be contemptuous of 'historical' data."[66]

Another reason analysts have been unreceptive to Dupuy's work is the Army historical community's failure to support his efforts. When government researchers solicited Army historians' comments on the HERO database, the historians were highly

critical of the HERO database. They disagreed with many of the facts, reported being unable to verify others, and objected to many historical interpretations imbedded in the data.[67]

Despite the failure of Dupuy to produce an acceptable database of historical military experience, the need for such a tool remains a concern to this day. The political scientist, John Mearsheimer, has observed that:

> The security affairs field badly needs a comprehensive historical database of the sort that Dupuy tried to create. Assembling such a database would require an enormous effort, involving years of labor by several people. Dupuy deserves much credit for attempting this important and difficult task, even if the results are not yet satisfactory.[68]

A second indicator of the Army's difficulties with military science is the recent literature of relative combat power assessment. Officers have long recognized the inadequacy of the existing methods of assessment.[69] In the early 1970s, the Army Concepts and Analysis Agency pioneered the Weighted Equipment Indices/Weighted Unit Value (WEI/WUV) methodology.[70] In this approach, the developers assigned categories of weapons, such as main battle tanks, a relative weight, then scored individual systems within each category. They derived a unit's relative combat power by multiplying the number of systems times that system's score times the category's weight.[71] Given a main battle tank category weight of 2.2, a U.S. tank battalion with 54 M-1 tanks, each scored at 1.2 would thus have a relative combat power of 142.56.

The chief criticism of the WEI/WUV system has been its inability to account for intangibles. In an unpublished 1976 CGSC staff study, then Major Huba Wass de Czege argued for the complexity of modeling relative combat power and the role of intangibles therein. He also suggested that many tactical commanders were more comfortable with using intuition instead of weapons system counts. [72] Two years later, Major Ralph G. Rosenberg observed that despite WEI/WUV technique, the field had not agreed upon methodology for assessing relative combat power. He proposed his own method based

on a set of unscientific and dubious assumptions about relative combat power. While Rosenberg's efforts were very simplistic, they are important nonetheless. Together with Wass de Czege's study, Rosenberg's article illustrates the profession's early dissatisfaction with the WEI/WUV methodology and its abiding interest in the non-quantifiable factors in relative combat power analysis.[73]

In the 1990s, two students at the School for Advanced Military Studies wrote monographs attempting to advance the science and practice of relative combat power analysis. Acknowledging the insufficiency of this approach, Major Allen D. Raymond adapted the WEI/WUV model for use by tactical staffs.[74] He surveyed officers asking their impression of the relative effectiveness of systems, then used the resulting statistical means to create his own indices.[75] In 1993, Major David R. Hogg produced a more substantial study of relative combat power analysis in the tactical Army. He applied models from Dupuy, TRADOC, the National Training Center (NTC), and CGSC texts to a standard scenario and demonstrated that they produced four widely variant assessments of relative combat power.[76] Hogg concluded the Dupuy's technique had the most merit. The author also observed that the NTC and CGSC models were the most influential but also the least satisfactory tools for assessing relative combat power.[77] Still, Hogg recognized that all these methods required adjustment to account for intangible factors.[78]

It is telling that the body of professional writing on relative combat power analysis in the U.S. Army since 1976 is so thin. It is indicative of the Army's neglect of the science of war. Despite the laudable efforts of a handful of authors, it is also demonstrates how far the officer corps must go before it can meet the challenge of assessing the tactical requirements for maneuver success.

Perhaps the brightest period in the development of American military science since 1976 can be associated with the advent of AirLand Battle doctrine in the 1980s. This doctrine caused some officers to seriously study the science of operational and tactics maneuver. One of the best examples of this resurgence of interest in the science of war is

a 1986 monograph by Major Peter S. Kindsvatter.[79] In it, the author studied corps movement planning using a historical comparison between a contemporary heavy corps and one of General George S. Patton's corps during the 1944-45 Ardennes Campaign. Interestingly, a conversation with one of the authors of AirLand Battle doctrine prompted the author to embark on this study. Then Colonel Leonard D. Holder had suggested to Kindsvatter that the Army failed to teach and practice the advanced staff skills needed to conduct operational maneuver at the corps level.[80] Holder himself later authored a superb and detailed study of heavy division march planning that *Military Review* published in 1988.[81]

Holder's article remains one of the few sources of usable planning factors available to heavy division maneuver planners. This is the case because as has been shown above, current Army doctrine largely neglects a meaningful discussion of the science of maneuver in heavy division operations. Still, the current state of doctrine and military history within the Army suggests it may be possible to address the lingering weakness of American military science. If the Army is to succeed in such an endeavor, it will have to start by making substantive changes to the core course tactics curriculum at CGSC.

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[1] Quoted in Carol Reardon, *Soldiers and Scholars: The U.S. Army and the Uses of Military History, 1865-1920*, ed. Theodore A. Wilson, *Modern War Studies* (Lawrence: University Press of Kansas, 1990), 1.
[2] *Field Manual 101-5 Staff Organization and Operations* (Washington, D.C.: Department of the Army, 1997), 5-7.
[3] Ibid., 5-12.
[4] Ibid.
[5] Ibid.
[6] *Field Manual 71-100 Division Operations* (Washington, D.C.: Department of the Army, 1996), 2-10.
[7] Ibid., 3-22 to 3-23.
[8] Ibid.
[9] Ibid., 3-24.
[10] *Field Manual 71-100-2 Infantry Division Operations: Tactics, Techniques, and Procedures* (Washington, D.C.: Department of the Army, 1993). The Army currently plans to consolidate all the infantry division manuals into a single manual that includes tactics, techniques, and procedures. This new *FM-71-100* is currently in production and its projected date of publication is March 2001. See *Combined Arms Doctrine Directorate, United States Army Combined Arms Center* [web page] (3 November [cited 17 November 1999]); available from http://www-cgsc.army.mil/cdd/admin/doc-lib.htm.

[11] In the preparation of this monograph, the author accessed the CALL Homepage (http://call.army.mil) on at least two separate occasions during October 1999. Multiple searches using relevant terms returned a multitude of documents with no apparent value to this study. In my personal opinion, the design of the web site and its confusing system of categorization defeats the Army's vision for CALL.
[12] *Field Manual 34-130 Intelligence Preparation of the Battlefield* (Washington, D.C.: Department of the Army, 1994), Appendix B.
[13] *FM 101-5*, 5-12.
[14] *FM 34-130*, B-1. Emphasis in the original.
[15] Ibid. One wonders why they did not simply omit this appendix altogether given the way it begins!
[16] *Field Manual 101-10-1 Staff Officer's Field Manual Organizational, Technical, and Logistical Data Planning Factors*, vols. I and II (Washington, D.C.: Department of the Army, 1987).
[17] *CGSC Student Text 101-6 G1/G4 Battle Book* (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1996), 1-6.
[18] See for example *FM 6-20-10 TTPs for the Targeting Process.*
[19] T.N. Dupuy, "History and Modern Battle: Practical Value Largely Unappreciated," *Army*, November (1982), 18.
[20] Roger J. Spiller, "In the Shadow of the Dragon: Doctrine and the U.S. Army after Vietnam," *RUSI Journal* , December (1997), 42.
[21] CPT Robert L. III Bateman, "The Uses of Military History," *Army* 49, no. 7 (July) (1999). Adapted from Dr. Allan R. Millett's work on the topic and Reardon, 2-5, 21-23,41.
[22] Reardon, *Soldiers and Scholar*, 211.
[23] Quoted in Reardon, 1.
[24] Ibid.
[25] John E. Jessup, Jr. and Robert W. Coakley, eds., *A Guide to the Study and Use of Military History* (Washington, D.C.: Center of Military History, 1979), 32.
[26] Walter C. Hermes, "The Use of Military History in Staff Work" in *A Guide to the Study and Use of Military History,* John E. Jr. Jessup and Robert W. Coakley, eds., (Washington, D.C.: Center of Military History, 1979), 373.
[27] Jessup and Coakley, 33-34.
[28] *Army Regulation 870-5: Military History: Responsibilities, Policies, and Procedures* (Department of the Army: Department of the Army) 1.
[29] Ibid.
[30] Ibid., 1-2.
[31] Ibid., 3.
[32] *Joint Publication 1-02: Department of Defense Dictionary of Military and Associated Terms* (Washington, D.C.: United States Department of Defense, 1994), 136.
[33] *Field Manual 100-5: Operations* (Department of the Army: Department of the Army), 1-1.
[34] Spiller, 41.
[35] John L. Romjue, *American Army Doctrine for the Post-Cold War, TRADOC Historical Monograph Series* (Fort Monroe, VA: Military History Office, U.S. Army Training and Doctrine Command, 1996), 11.
[36] Ibid., 11-13.
[37] Ibid., 13.
[38] The manual retained the FSR moniker until 1968. Ibid., 13-14.
[39] Spiller, 49.
[40] Ibid., 45.
[41] See Christopher R. Gabel, *Seek, Strike, and Destroy: U.S. Army Tank Destroyer Doctrine in World War II*, ed. Combat Studies Institute, vol. 12, *Leavenworth Papers* (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1985), for the definitive work on this topic.
[42] Spiller, 49.
[43] Ibid., 42 and MAJ Paul H. Herbert, *Deciding What Has to Be Done: General William E. DePuy and the 1976 Edition of FM 100-5, Operations, Leavenworth Papers No 16* (Fort Leavenworth, KS: Combat Studies Institute, U.S. Army Command and General Staff College, 1988), 106.
[44] Herbert, 1.

[45] John L. Romjue, *From Active Defense to AirLand Battle: The Development of Army Doctrine 1973-1982, TRADOC Historical Monograph Series* (Fort Monroe, VA: Military History Office, U.S. Army Training and Doctrine Command, 1984), 13.
[46] Anonymous, "In Pursuit of the Essence of War," *Army*, January (1984), 21.
[47] Paraphrased from James J. Schneider, "The Origins of Soviet Military Science," *The Journal of Soviet Military Studies* 2, no. 4 (1989), 492.
[48] Reardon, 3.
[49] Quoted in Reardon, 9. Emphasis in the original.
[50] Russell F. Weigley, *The American Way of War: A History of United States Military Strategy and Policy* (New York: Macmillian Publishing Co., 1973), 212.
[51] Ibid., 213.
[52] Marshall, 14.
[53] MAJ Peter S. Kindsvatter, "An Appreciation for Moving the Heavy Corps - The First Step in Learning the Art of Operational Maneuver" (MMAS monograph, U. S. Army Command and General Staff College, 1986), 36-37.
[54] Marshall, 92.
[55] Marshall, 79.
[56] *DA Pamphlet 600-3: Commissioned Officer Development and Career Management* (Department of the Army: Department of the Army), 194-196.
[57] Robert McQuie, "Military History and Mathematical Analysis," *Military Review*, May (1970), 8.
[58] Anonymous, 19.
[59] Ibid., 21.
[60] Ibid., 21.
[61] McQuie, 17.
[62] John R, Brinkerhoff, introduction to T.N. Dupuy, *Numbers, Predictions and War: Using History to Evaluate Combat Factors and Predict the Outcome of Battles*, 1985 Revised Edition ed. (Fairfax, VA: HERO Books, 1985), xvii.
[63] Dupuy, *Numbers, Predictions and War*, 4.
[64] Ibid., 18.
[65] Ibid., 141.
[66] T.N. Dupuy, "Criticisms of Combat Models Cite Unreliability of Results," *Army*, March (1985), 16.
[67] *Analysis of Factors that have Influenced Outcomes of Battles and Wars: A Data Base of Engagements and Battles* (Washington, D.C.:U.S. Army Concepts Analysis Agency, 1984), 2-2 and Appendix A and also John J. Mearsheimer, "Assessing the Conventional Balance: The 3:1 Rule and Its Critics," *International Security* 13 (Spring), no. 4 (1989), 66-67.
[68] Mearsheimer, 67. See note 30.
[69] See for example Major David W. Daignault, "Four F's of Force Ratio," *Armor*, March-April (1977): 28-29.
[70] MAJ Allen D. Raymond, "Assessing Combat Power: A Methodology for Tactical Battle Staffs" (MMAS Monograph, U.S. Army Command and General Staff College, 1991), 11-12.
[71] MAJ David R. Hogg, "Correlation of Forces: The Quest for a Standardized Model" (MMAS Monograph, U.S. Army Command and General Staff College, 1993), 8.
[72] MAJ Huba Wass de Czege, "Understanding and Developing Combat Power," 1976, unpublished typescript in the collection of the Combined Arms Research Library, Fort Leavenworth, KS, (hereafter CARL), 2.
[73] Major Ralph G. Rosenberg, "Relative Combat Power," *Military Review* LVIII, no. 3 (1978), See note 2 especially.
[74] Raymond, 13.
[75] Ibid., 14-15.
[76] Hogg, 10-13.
[77] Ibid., 34, 41.
[78] Ibid., 1.
[79] Kindsvatter.
[80] Ibid., 2-3.

[81] Colonel L.D. Holder and Major Edwin J. Arnold, "Moving the Heavy Division," *Military Review*, July (1988), 35-49.

CHAPTER THREE

THE ALCHEMY OF CGSC TACTICS INSTRUCTION, 1976-1998

> Operations officers at division and corps level should carry the size of their units and the related time and space factors in their heads and in their notebooks.
>
> LTG L.D. Holder[1]

If the Army is to preserve a usable body of military science applicable to heavy division operations, the Combined Arms Center (CAC) at Fort Leavenworth, Kansas will have to play an important part. Not only is CAC TRADOC's integrating center for doctrine and the combatant arms, but it is the home of the U.S. Army Command and General Staff College (CGSC). Since its inception, CGSC has educated mid-career officers in the doctrine, procedures, and techniques for large unit operations such as those of a heavy division. CGSC graduates, both resident and non-resident, compose the bulk of the Army's division staff officers. These majors' expertise in planning division operations is largely a product of the College's curriculum. A review of that curriculum since 1976 suggests that CGSC has not adequately educated its graduates in the science of division operations.[2] For most of the period, the College has divided tactics instruction between core course and electives, the advanced applications program. The core course tactics course are the most germane to this study because all graduates, regardless of branch, component, or residency status must demonstrate some mastery of this material. It forms the shared tactical bias of all CGSC graduates and by extension the staffs of the Army's divisions.

It is important to begin this examination by recognizing that division tactics composes only a small — albeit important component — of the CGSC curriculum. Between 1976 and 1996, each CGSC class received on average 225 hours of core course tactics instruction. Division operations averaged only twenty-nine percent of those hours,

with the balance taken up by varying mixes of general tactical, battalion, brigade, and corps operations instruction.[3] (See Figure 3-1) Doctrine is the driving force that shapes CGSC tactics instruction, but the allocation of time and weighting of subjects reflects the views of the faculty and especially the Director of the Center for Army Tactics (CTAC). Course authors, instructional committees, and individual instructors have limited latitude in designing and presenting tactics instruction.[4]

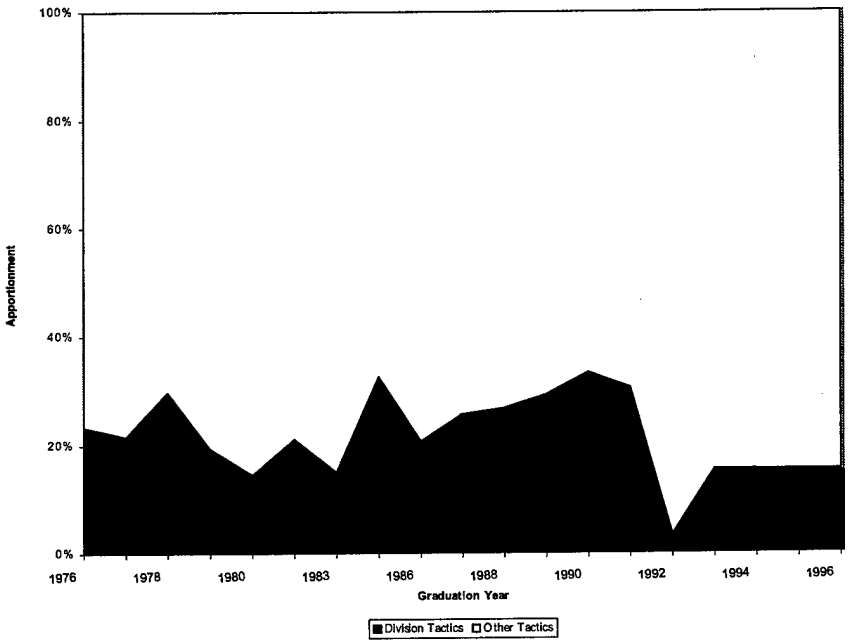

Figure 3-1 Apportionment of CGSC Core Course Tactics Instruction to Division Operations, 1976-1996

To understand the science of heavy division operations in the CGSC curriculum between 1976 and 1998 it helps to divide the period into three eras: Active Defense, AirLand Battle, and Post-Cold War. The prevailing Army doctrine defined the first two, while a seismic change in the geopolitical environment shaped the third. Study of the student materials and references supporting core course tactics instruction in each era suggests a generally low level of attention to the temporal, spatial and relative combat

power aspects of military science. On a more positive note, it also reveals a few years in which military science briefly flowered in the Leavenworth curriculum.

The Active Defense Era, 1976-1981

The Active Defense Era was the dark ages of military science at CGSC. Between 1976 and 1981, there was little evidence of any science of heavy division operations in the CGSC core course tactics instruction. Leavenworth did not provide students with a battlebook during these years. In the late 70s, student received two references *RB 100-7 The Common Language of Tactics* and *RB 101-1 Organizational Data for the Army in the Field.* The former was a glossary of doctrinal terms, the latter specified the structure, mission, broadly framed capabilities, and equipment of the notional units used in exercises at the College.[5] While useful in their own right, these books added nothing to the student officer's grasp of the science of division operations. Toward the end of this era, the College stopped issuing *RB 101-1* and *RB 100-7,* replacing them with an "Offensive Workbook." It included terms and symbology, document formats, and weapons data, along with some combat support and combat service support planning factors.[6] It compares unfavorably with even the most primitive of the battlebooks Leavenworth issued in the era that ensued.

Temporal factors were almost completely missing from the CGSC curriculum of the Active Defense era. In 1976-77, the only reference to them in the four core tactics courses was a programmed text on tactical movement planning. Under the title "Preparation Time Factors," the text gave historical examples of temporal planning factors. It offered estimates of the time required for the lead vehicles of infantry and armored/mechanized units to reach a march start point under day and night conditions. The course author warned that this data was "based on experience from World War II and the Korean War and can be applied in the future only with judgement and discrimination."[7]

Spatial planning factors did not appear in the Leavenworth tactics curriculum until 1979. That year the unnamed authors of an introductory course on offensive operations, P312, observed that doctrine did not prescribe attack frontages for Army units. They apparently considered this a deficiency because they subsequently provided students with a Soviet table that gave the widths of attack zones, and tank and personnel carrier densities per kilometer for U.S. armored, mechanized, and infantry divisions and brigades.[8]

During the late 1970s, CTAC slowly awoke to the need for a reasonable methodology and set of planning factors for assessing relative combat power. In the first two years of the era, there was no mention of relative combat power at all. It first appeared in a 1978 lesson on defensive planning in Europe. The lesson author called for the assessment of relative combat power based upon conversion of Soviet units to U.S. equivalents, but no evidence of the suggested methodology remains.[9] Echoing the factor in the 1976 edition of FM 100-5, the lesson specified "acceptable combat ratios" for units in the covering force at 1:6 and at 1:3 in the main battle area.[10] A portion of the lesson labeled "An Analytical Approach to Terrain Analysis and Allocation of Combat Power" recognized that a weakness of Active Defense was the problem of time-distance in lateral repositioning. It is symptomatic of this era of CGSC instruction that the course failed to suggest any planning factors to help officers overcome that weakness. This lesson indicated that officers should allocate forces to defend avenues of approach based upon an unmodified comparison of the number of battalions and desired ratios.[11] In a later lesson, the course required students to apply this methodology in the context of situational exercise.[12] This instruction on terrain analysis and combat power allocation remained unchanged in the Leavenworth curriculum through 1980.[13]

In 1979 and 1980, Leavenworth explored more sophisticated approaches to relative combat power analysis. One course author observed in 1979 that there was "still no single approved method of measuring relative combat power."[14] That year CGSC taught

that U.S. and Soviet divisions had equivalent combat power, but that a U.S. battalion had the power of 1.4 Soviet battalions.[15] The unnamed author above made an effort to expose the students of P314 to the current professional literature of relative combat power. He described HERO's methodology and required students to read three recent journal articles with varying perspectives on the topic. Ultimately, he left the issues of relative combat power analysis unresolved. Its author reminded officers that, "in all cases, the tactician should be able to describe and defend any method he uses...."[16] No doubt, this was reasonable expectation, but the Army's primary school for training division staff officers owes its graduates much more. Clearly in the Active Defense Era, Leavenworth failed to impart a usable body of scientific knowledge about heavy division maneuver.

The AirLand Battle Era, 1982-1991

During the AirLand Battle Era, CGSC made halting progress in integrating the science of heavy division offensive and defensive operations into it curriculum. Although the core tactics courses themselves saw little improvement, the reference materials, especially *Student Texts 100-3* and *100-9* at least made an effort to introduce some discussion of spatial, temporal, and relative combat power planning factors. Despite this progress, the overall tone of the instruction remained skeptical if not hostile to quantitative methods as they applied to division operations.

During this era, there was only scattered evidence of the science of heavy division operations in course materials. For example, the 1982-83 core offensive tactics course included a lesson on course of action development in which students analyzed relative combat power and "time distance and space factors as they affect employment of combat power." [17] For the first task, the course materials gave only a very general description of why and where it is necessary to determine relative combat power. They failed to furnish any guidance on *how* to do it.[18] Despite renewed attention to tactical and operational maneuver in the doctrine of the day, the curriculum gave only passing attention to the

temporal and spatial aspects of operations. These topics appeared in only two years' curriculum. In 1983, there was a single lesson on tactical movements that included a review of movement planning calculations.[19] Three years later, the subject surfaced again in a course on combined arms fundamentals where an enclosure to the lesson included a division movement overlay. In the accompanying text, the author proclaimed that "to be an effective planner at corps and division level, one must have a grasp of just how large these organizations are." To aid students in this task, he broke out the numbers of tracked and wheeled vehicles in a contemporary armored division then provided some road space planning figures. The lesson material also included a fold out map depicting the division arrayed on German terrain.[20] In an amazing demonstration of the lackadaisical approach to military science at CGSC, the College has republished the author's original figures every year for more than a decade, this despite the substantial changes in the organization of the division.

The AirLand Battle Era saw very significant developments in the realm of references issued to support tactics instruction at CGSC. The Offensive Workbooks persisted until 1983 when the *ST 100-9* series began its run. The first edition made a significant if hesitant effort to address some of the science of heavy division operations. In terms of relative combat power analysis, it noted that unspecified "historical experience" suggested that a 1:3 ratio gave the defender a fifty-fifty chance of success. The author was clearly uncomfortable making this advice. Evoking the mantra of situational dependance, he reminded his students that:

> these ratios are merely guidelines and should not in any way be considered as rigid standards. The specifics of METT-T impact significantly on the required friendly-to-enemy ratios.[21]

ST 100-9 also addressed relative combat power analysis in the context of wargaming. The author suggested that determining losses in wargames was "more art than science as it requires experience and tactical judgement to produce a credible estimate" and noted that "historical studies and computer simulations" indicated a 1:3 to 1:4 loss ratio for the

defender and attacker respectively. Nonetheless, the author emphasized that qualitative judgment must temper the quantitative process of determining losses.[22] The 1983 *ST 100-9* also addressed temporal planning factors. It pointed out the need for staffs to assess the time and distance requirements of various actions during wargaming. To aid them in that process, the document provided rates of advance tables as "a starting point," using the unopposed rates adapted from the 1978 *FM 7-20 The Infantry Battalion* and opposed rates "adapted from CACDA Jiffy War Game"[23]

The 1986 edition of ST 100-9 provided some more developed planning factors mitigated by a strong dose of skepticism about the utility of quantitative methods.[24] It added a table with unopposed rates of movement as influenced by terrain classification (go, slow-go, and no go, respectively).[25] The author warned students that those assessing relative combat power "must keep in mind that there is no direct relationship between force ratios and attrition or advance rates." He bolstered his argument with a quote from Jomini to the effect that war is "in no way a mathematical operation."[26] Despite this attitude, the document placed more emphasis quantitative tools than had previously been the case. It dismissed the old method of calculating force ratios based on raw battalion counts as "inappropriate" at division level. In its place, the author indicated that the division G-3 had responsibility for approving whatever quantitative system the staff developed. *ST 100-9* itself suggested one such model.[27] The author's willingness to advocate some quantitative tools even extended to Dupuy's work with HERO. In discussing attrition in wargaming, the author cited figures from Dupuy's *Numbers, Predictions, and War* and *FM 101-10-1* as general guidelines.[28] Interestingly, the following year's edition of *ST 100-9* dropped the reference to Dupuy and dumped the whole issue back in the lap of the staff without any suggested methodology.[29]

The second major development of the era was the introduction of *ST100-3,* the CGSC Battlebook. It first appeared in curriculum for the Class of 1986. By the standards of the editions that followed, this first effort was rudimentary. While it

contained considerable reference data, the original battlebook only included a handful of planning factors and those addressed only supporting arms.[30] In terms of their military scientific content, the 1987 and 1988 editions of the battlebook were one of the better planning tools CGSC has ever produced.[31] These editions had a section on battlefield clutter that repeated the figures and overlay of an armored division on the march discussed above. In a major departure from previous practice, these editions had an appendix showing that same division in a defensive array on German terrain as a way of illustrating its battlespace requirements. While neither discussion delved into specific temporal and spatial planning factors, they did succeed in conveying a very strong impression of the division's footprint. These battlebooks also included a section on a division passage of lines that gave examples of the planning calculations required to make such a complex operation feasible.[32] Sadly, the 1990 battlebook deleted all references to the appendices above and cut out the paragraph on the division defensive array.[33] This change illustrates the halting nature of the progress during the AirLand Battle Era. While the core tactics curriculum continued to overlook the science of war, *STs 100-3* and *100-9* introduced CGSC students to aspects of the science of heavy division operations that heretofore Leavenworth had largely ignored.

The Post-Cold War Era, 1992 to Present

Since the end of the Cold War, the science of heavy division operations has receded within the CGSC core course tactics instruction. Temporal, spatial, and relative combat power factors have disappeared from view in course materials, subsumed within the MDMP instruction and exercises. At the same time, ST 100-9 disappeared after 1992 along with its useful, if unscientific, planning factors for force ratios and rates of advance.[34]

In its absence, the only remaining source of planning factors outside doctrine has become *ST 100-3*. However, the quality and quantity of planning factors in *ST 100-3* has

varied widely since 1991. The 1992 edition was a much smaller document, with only a few traces of the science evident in the previous editions. It provided, for example, neither relative combat power factors nor rates of advance.[35] This leaner and less scientific version of the battlebook continued unchanged until 1996. That year it ballooned with hundreds of pages of reference data including a significant infusion of maneuver planning factors.[36] It added some spatial and temporal factors for planning a corps roadmarch as well as a time distance table and more detailed movement conversion tables.[37] The most significant addition was Section VIII Battlefield Calculations. It included factors for determing target exposure times and — for the first time — unit frontages at battalion and below level.[38] While many of these factors were not germane to division planners, their inclusion reflected an unusual effort to codify some of the science of tactics.

The 1997 edition of *ST 100-3* took both a step forward and a step back. On the positive side, it added a dated relative combat power values table and a new procedure for assessing relative combat power. Within a new chapter on MDMP, the author articulated a two step process for relative combat power analysis. It called for officers to first calculate absolute combat power using the table mentioned above, then calculate relative combat power using the "Relative Combat Power Analysis" system – a matrix for systematic analysis of subjective factors.[39] Changes to the Battlefield Calculations chapter were less beneficial. It reduced the level of details in division tactical roadmarch passage and eliminated the movement tables altogether.[40] Regrettably, the author also elected to eliminate the unit frontages data from previous edition.[41]

Despite minor victories in the AirLand Battle Era, CGSC core course tactics instruction since 1976 has largely neglected the science of division offensive and defensive operations. Given that this period corresponds with the Army's enormous efforts to prepare for mechanized warfare in both Europe and Southwest Asia, it is disturbing that CGSC has failed to address the physics of these operations in a

meaningful way. This neglect for the science of war confirms the Army's inability to come to terms with its tradition of tactical alchemy and bodes ill for its ability to retain its institutional expertise in heavy division operations.

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[1] Ibid., 39.
[2] The author found the curricular files in the CGSC archives disappointingly incomplete. Some years' files and a few courses are missing entirely. Without exception, the extant records consist of only the materials (student texts, advance sheets, etc.) issued to students. The supporting correspondence, files, and documents that would be useful in reconstructing how the faculty developed, executed, and assessed these courses has not been preserved.
[3] These figures were derived by examining the contents of the 1976-1996 editions of "CGSC Circular 351-1: CGSC Catalogue," U.S. Army Command and General Staff College Archives (thereafter USACGSCA), CARL. Only core courses of apparent relevance were included in the count.
[4] LTC Greg Brockman, C300 Course Author, AYs 1999-2000, interview by the author, 2 November 1999.
[5] "RB 100-7 The Common Language of Tactics, July 1975," USACGSC Regular Course 1975-76, Vol 5 Subjects 2565 thru 3130, USACGSCA and "RB 101-1 Organizational Data for the Army in the Field, June 1975," USACGSC Regular Course 1975-76, Vol 5 Subjects 2565 thru 3130, USACGSCA.
[6] "Offensive Workbook," P312 Introduction to Offensive Operations, USACGSC Regular Course 1978-79, Subjects P312-P313, USACGSCA.
[7] Appendix 1 to Advance Sheet, Period 7. Programmed Instruction – Tactical Movement Planning, Course 3141: Contingency Force Operations (Middle East Setting), USACGSC Regular Course 1975-76, Vol 6 Subjects 3141 thru 3161, USACGSCA, P7-37.
[8] Lesson 1. Introduction and Fundamentals, P312 Introduction to Offensive Operations, USACGSC Regular Course 1978-79, Subjects P312-P313, USACGSCA, L1-15. This was repeated the following year as well. See Lesson 1. P312 Introduction to Offensive Operations, USACGSC Regular Course 1979-80, Vol. 1 Subjects C301-P312, USACGSCA.
[9] Lesson 1. Introduction to Defensive Planning "Sequence of Defensive Planning", P313: Forward Deployed Force Operations (European Setting), USACGSC Regular Course 1977-78, Subjects P312 thru P313, USACGSCA, L1-I-1.
[10] Ibid., L1-II-1.
[11] Section IV, Lesson 1. Concepts for Defensive Planning "An Analytical Approach to Terrain Analysis and Allocation of Combat Power," Lesson 1. Introduction to Defensive Planning "Sequence of Defensive Planning", P313: Forward Deployed Force Operations (European Setting), USACGSC Regular Course 1977-78, Subjects P312 thru P313, USACGSCA, L1-IV-1, L1-IV-19.
[12] Lesson 4, Division Defensive Operations, P313: Forward Deployed Force Operations (European Setting), USACGSC Regular Course 1977-78, Subjects P312 thru P313, USACGSCA.
[13] P313 Forward Deployed Force Operations (European Setting), USACGSC Regular Course 1978-79, Subjects P312-P313, USACGSCA.
[14] Section III, Lesson 2. Concept of Relative Combat Power. P314 Offensive Operations — European Setting, USACGSC Regular Course 1978-79, Vol. 1 Subjects P314-A353, USACGSCA, L2-III-1.
[15] Ibid.
[16] Ibid., L2-III-1 to L2-III-2.
[17] Tab 1 to Inclosure A to Appendix 5 to Advance Sheet, Lesson 5 Analysis of a Course of Action Methodology, P312 Offensive Tactics,USACGSC Regular Course 1981-82, Subjects P312 thru P317), USACGSCA, 106 and P312 Offensive Tactics, USACGSC Regular Course 1982-83, (Subjects P312), USACGSCA.
[18] Tab 2 to Inclosure A to Appendix 5 to Advance Sheet, Lesson 5 Analysis of a Course of Action Methodology, P312 Offensive Tactics,USACGSC Regular Course 1981-82, (Subjects P312 thru P317), USACGSCA, 109-110.

[19] Section II, Lesson 3 Tactical Movements, P113 Command Control and Communications, USACGSC Regular Course 1982-83, (Subjects P112 thru RB 3-1), USACGSCA, L3-II-1.
[20] Enclosure C Division Movement Overlay to P311 Combined Arms Fundamentals, July 85, USACGSC Regular Course 1985-86, (Subjects ST100-3 thru P312), USACGSCA, 33.
[21] *RB 100-9 A Guide to the Application of the Estimate of the Situation in Combat Operations*, September 1982, USACGSC Regular Course 1982-83, (Subjects P313 thru P318), USACGSCA, 2-33. Emphasis in the original. For sake of consistency, the author will refer to this addition as ST 100-9.
[22] Ibid., 2-54 to 2-55. He even went so far as to call analysis of this type a creative act!
[23] Ibid., 2-53 to 2-55, 2-61 to 2-62.
[24] *ST 100-9 A Guide to the Estimate of the Situation*, July 1985, USACGSC Regular Course 1985-86, (Subjects ST100-3 thru P312), USACGSCA.
[25] Ibid., 3-20.
[26] Ibid., 4-3.
[27] Ibid., 4-4 to 4-5.
[28] Ibid., 5-14.
[29] *ST 100-9 The Command Estimate*, July 1986, USACGSC Regular Course 1986-87, (Subjects P318), USACGSCA, 5-13.
[30] *ST 100-3 Battle Book*, Department of Tactics, June 1985, USACGSC Regular Course 1985-86, (Subjects ST100-3 thru P3121), USACGSCA
[31] *ST 100-3 Battle Book*, Center for Army Tactics, 1 April 1987, USACGSC Regular Course 1986-87, (Subjects P318), USACGSCA. The only change in the 1988 edition was the date of publication.
[32] Ibid., 3-4 to 3-7.
[33] *ST 100-3 Battle Book*, Center for Army Tactics, 1 April 1989, USACGSC Regular Course 1989-90, USACGSCA.
[34] *ST 100-9, The Command Estimate Process*, July 1992, USACGSC Regular Course 1991-92, Container "Fundamentals of Combat Operations, C310/1993," USACGSCA.
[35] *ST 100-3 Battle Book*, Center for Army Tactics, 1 April 1991, USACGSC Regular Course 1991-92, Container "Fundamentals of Combat Operations, C300/1992," USACGSCA.
[36] *ST 100-3 Battle Book*, Center for Army Tactics, 1 June 1996, USACGSCA.
[37] Ibid., 2-93 to 2-99.
[38] Ibid., 2-99 to 2-104.
[39] *ST 100-3 Battle Book*, Center for Army Tactics, 1 July 1997, USACGSCA, 8-22 to 8-26.
[40] Ibid., 9-1.
[41] Ibid., 9-3 to 9-5.

CHAPTER FOUR

AN ALTERNATIVE APPROACH: THE SCIENCE OF WAR IN THE FORMER SOVIET UNION

> The days when decisions in the command and control of forces could be made based upon the individual experience and intuition of the commander alone are long past.
>
> A. Ya Bayner[1]

> Not knowing the military past, it is impossible to understand the present and to foresee the future.
>
> Colonel-General F.F. Gairoronskiy and Colonel M.I. Galkin[2]

In the second half of the twentieth-century, the U.S. Army's most dangerous potential adversary was the Red Army of the former Soviet Union. Throughout the Cold War, but especially in the years after the Vietnam War, the Army expended an enormous effort studying the Soviet's way of war. This analysis produced a rich harvest of basic intelligence and informed debate over the direction of Army doctrine. Indeed, the emergence of an American operational art in the 1980s sprang in part from a focused effort to understand the workings of the Soviet's operational art.[3] The products of the intense American study of the Soviet military also serve to illustrate how fundamentally differently the superpowers approached doctrine, military science, the utility of military history, and finally, staff planning procedures. Contrasting the Soviet and American approaches to military science suggests some actions the Army can take to preserve its knowledge of combined arms mechanized warfare.

The first step to understanding these issues from the point of view of the former-Soviet Union is to place them in context. The Soviet Union provided exceptionally fertile ground for the systematic study of military experience and the codification of military science. The prescriptive nature of Marxism-Leninism allowed for the formulation of a unified body of thought linking all aspects of military affairs within the worldview of Communist ideology.

From this standpoint, military affairs like every other human endeavor were subject to discoverable objective laws. War was a social phenomenon governed by laws that reflected the complex relationship between the technological, ideological, and historical forces at work in war. Thus, success in war was a matter of understanding and applying these laws.[4] Such an approach stands in marked contrast to Western thought where the notion of laws with universal applicability to war has found little support.

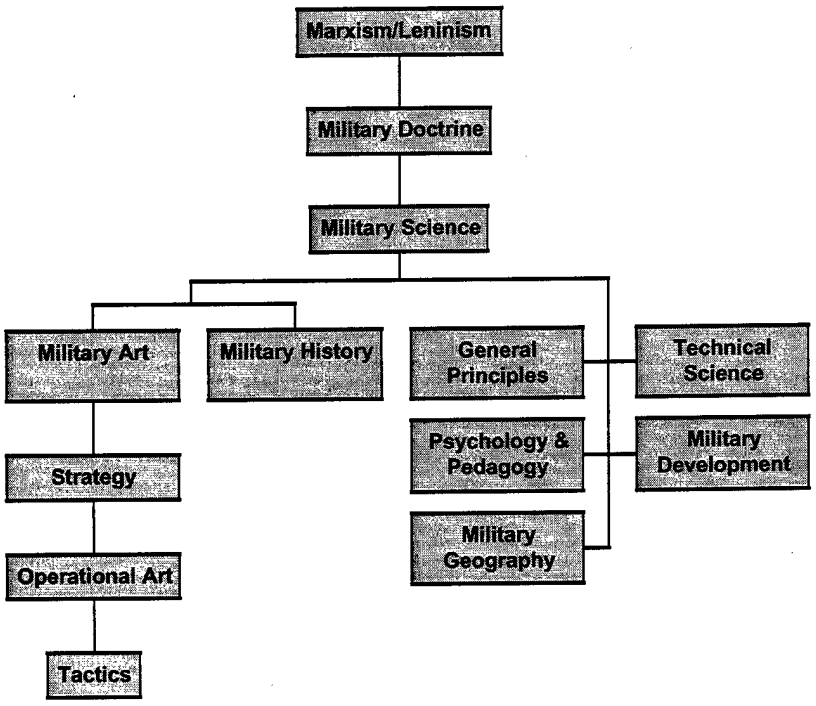

Figure 4-1 The Hierarchical Relationship by Doctrine, Military Science, and Military Art in the Former-Soviet Union[5]

From these general laws of war, the Soviets derived their military doctrine. They ultimately defined doctrine as "the officially accepted set of concepts that delineate the ways and means to achieve military objectives in the interest of politics."[6] This definition was a marked change from previous Russian military experience. The Czarist Army first introduced the idea of doctrine in the wake of its defeats in the Russo-Japanese War. This prompted a debate among contemporary Russian officers over the nature of doctrine. Some feared it would become dogma

that would hamstring the genius of commanders. Others saw doctrine as a means to improve the tactical performance of the army at a time when its effectiveness was in question. Russian officer hotly debated these issues until Czar Nicholas II closed the issue by declaring that "military doctrine consists of doing everything I order."[7]

Like the Czar himself, this shallow conception of doctrine did not survive the Revolution. When debate over doctrine resumed, the leading minds of the Red Army moved quickly to bring doctrine in line with V.I. Lenin's interpretation of Marxism. M.V. Frunze argued for a unified military doctrine, one in which political ideology fused with technical aspects of doctrine. From Frunze's viewpoint, class-consciousness would naturally animate the mass armies of the workers' state and doctrine should reflect this tight integration of military and political affairs. Frunze's views prevailed over the looser interpretation of Leon Trotsky, the People's Commissioner for Military and Naval Affairs, and gave Soviet military doctrine an inherently political aspect.[8]

This political dimension largely removed doctrine from the hands of the military. Throughout its existence, the focus of the Soviet state remained fixated on survival. Its leadership optimized the organization of the state to ensure its ability to prevail in an intense and extended conflict with hostile capitalism.[9] Since the ultimate manifestation of this conflict was war, the Communist Party reserved for itself the authority to articulate military doctrine. Consequently, this doctrine was not subject to debate within the military.[10] Instead, it became the foundation upon which officers constructed the military apparatus of the Soviet warfare state with the technological means at hand. Its directives were legally binding and intended to create a common cultural bias within the military.[11] Thus, Soviet military doctrine was an inherently authoritarian and politicized means for coordinating the activities of a mass army and the sanctioned framework for interpreting military history and experience.[12]

Within the context of the military doctrine established by the Party, Soviet military officers had responsibility for developing military science. It is important to recognize that the Russian term for science carries a different connotation than the English word. Its meaning places greater

emphasis on the practical application of knowledge as opposed to the Western emphasis on the theoretical aspects of science. [13] Soviet military science further differs from Western practice in that early on, the leadership of the Soviet military moved to ensure that it was an officially recognized science that operated within the bounds of Friedrich Engels' dialectical materialism.[14] The Soviets also recognized the utility of science as a predictive tool. [15] According to the Soviet *Officer's Handbook*, "the duty of science... is to pave the way for practice and to foresee the course of events."[16] Given this emphasis on practice and prediction, it is hardly surprising that unlike in the domain of doctrine, there was room for debate on military science within the-Soviet military.[17]

As in the case of doctrine, previous Russian experience informed the efforts of early Soviet military leaders to fashion their specific science. By the middle of the nineteenth-century, Russian officers were already cognizant of the need for commanders to plan based on something more reliable than individual intuition and experience.[18] In the last years before the Revolution, some had begun to experiment with the use of mathematical models derived from historical data as a means for placing military planning on a scientific basis.[19] The development of military science continued in that vein after the Revolution. One of the Soviets' leading inter-war military writers, V.K, Triandafillov, argued for the development of quantitative tools to evaluate the feasibility of plans because the genius of commanders alone was inadequate.[20] In his capacity as Chief of Staff of the Red Army and Chief of its Military Academy, Frunze played an essential role in instituting a military science based on the quantitative analysis of recent operations.[21] Again, this marks a significant departure from the Western experience, where the application of the tools of quantitative analysis to military planning did not become fashionable until the 1960s. Even then, as argued above, they have been inconsistently and ineffectively applied to tactical and operational planning within the U.S. military.

Under the umbrella of military science, the Soviets recognized seven distinct endeavors. (See Figure 4-1) Among these were military geography, military technical science, military psychology and pedagogy, military development, general principles of military science, military

art, and finally, military history. [22] While equal in Soviet eyes, all but the last two are ancillary to this study. The Soviet approach to military science required that they embed military history within it. By definition, Soviet military science analyzed "the military-historical experience accumulated" by the nation.[23] Or in the words of the Soviet *Officer's Handbook*, "science makes a profound study of the past, extracting from it all that is valuable and useful for the present and the future."[24] Since they valued history as the raw material for their military science, the Soviets expended enormous resources in saving storing and analyzing their military experience.[25] In one measure of this effort, a 1980's British study estimated that there were more than a thousand military historians working within the Military History Directorate of the Soviet General Staff.[26] These historians engaged in a deliberate process of historical "mining" with four phases: data collection, data analysis, applying the lessons, and final verification.[27] Note that the Soviets actively adjusted their findings to compensate for technological changes in the tools of war and verified the results with operational testing before publishing the resulting planning guidelines.[28] Later, the Soviets also studied the development of operations research methodology in the West and brought its tools to bear on the analysis of historical experience.[29]

By far the Soviets saw the richest field for historical exploitation in their own experience in the Second World War. As one Western analyst noted:

> Since 1945, using the scientific tool of military history, Soviet military doctrine has sought to reduce the uncertainties of the modern battlefield by means of a series of statistical calculations to establish standards of activity and thereby ensure an objective and common approach to the planning of future campaigns and operations.[30]

For example, studies of World War II led Soviet military scientists to important conclusions about the correlation of forces in planning. Rather than asserting an unproven or intuitive relationship, as Western analysts are wont to do, Soviet researchers produced a precise, substantiated, mathematical model. It demonstrated that "the greater the attackers superiority in forces and means, the quicker he attained the goal of the battle and operation and the higher the rates of advance."[31] In doing so, their model for the correlation of forces became a planning tool

Soviet staffs could use as the basis for determining objectives — in effect defining the realm of the possible.[32] Again the Soviet's analysis of their World War II experience stands in contrast to the ways in which the U.S. Army has used its own rich heritage from that war. The Center for Military History succeeded in completing a mammoth official history of the Army's role in the war. Unlike the Soviet case, this work and the enormous documentary record that supports it appears to have produced little of tangible benefit for maneuver planners at the division level. Indeed, the best that one can say is that this work has contributed to the general military education of postwar officers and has indirectly influenced Army doctrine.

Whereas the U.S. Army places military art and science on an equal plane, the Soviets subordinated art to science. From their perspective, skill in strategy, operational art, and tactics, the components of military art, came from an understanding of the scientifically derived principles that shaped it. These principles of military art were in Soviet words "the base ideas and most important recommendations for the organization and conduct of a battle, an operation, or a war as a whole."[33] They provided "a reliable basis for the commander to make correct decisions" and observation of them "kept a commander from mistakes and directs him on the right path."[34] The principles ensured a minimum level of competence; they provided for what the U.S. Army labeled "safe" leadership. The purpose of the Soviet military educational system was to educate officers in these principles of military science, enabling them to be safe practitioners of the military art.[35]

To this end, the cornerstone of officer education in the Soviet Union was instruction in the application of military science in a tactical setting. Tactical planning in the Soviet Army reflected the disciplined approach the Soviets took to the study of military history and science. Algorithms and mathematical models drawn from historical and exercise data guided tactical planning.[36] As one American officer colorfully described it, these quantitative tools of Soviet military science were the "warp and woof" of an officer's training.[37] They found expression in Battle Regulations with the force of law.[38] The Soviet tactical planning process involved four steps: mission receipt, clarification of the mission, evaluation of the situation, and finally,

making a decision. In the third step of this process, Soviet officers applied norms to evaluate the enemy, themselves, flanking units, terrain, weather, time of day and time of year.[39] As both "performance standards, expressed in numerical form" and "a mathematical prescription for proper action," planning norms guided commanders to select the optimal course of action.[40] In a larger sense, norms served to make war more predictable and calculable for the Soviets. They allowed them to place a greater reliance on tactical drills that in turn enabled a higher tempo of operations.[41] Norms also permitted commanders to make rapid decisions in combat situations where time is compressed and leaders are customarily overwhelmed with information.[42]

In the assessment of U.S. doctrine writers in the 1980s, the strength of this system was that it made tactical performance by sub-units predictable. It also made Soviet officers cognizant of time and space factors in combat. Its weakness was that it induced mental rigidity and made the Soviets more vulnerable to the effects of friction.[43] For their part, Soviet writers emphasized that planning factors enabled creativity because they freed commanders to focus on adapting to the unique conditions they faced in battle.[44] Still, the Soviets and their Russian successors recognize that norms intended to allow for creativity and situational factors often were all too often transmuted in practice into dogma.[45]

The taxonomy of Soviet military science divided planning norms into three broad categories: logistical, temporal and spatial operational-tactical norms. [46] The content of the first two is self-evident. The third embraced the time and space required for combat units to execute operational and tactical tasks. It also addressed the influence of terrain on these tasks. Examples of spatial operational-tactical norms include those that address the depth of battle tasks, dimensions of zones, areas, and sectors; areas of groupings of forces; and the scale of redeployments. Soviet planning norms even applied to the staff and command functions; they used PERT charts for time apportionment in planning.[47] For example, norms allowed thirty minutes for a trained staff to receive and analyze a mission, three to four hours for staff estimates, forty to sixty minutes for the commander to select a course of action, and finally forty minutes to generate an order.[48] This is an impressive time standard for tactical planning. If the

staffs of Soviet divisions were consistently able to meet these planning norms, it suggests that the U.S. Army could learn much from embracing parts of the Soviet approach.

To aid commanders and staffs in applying norms, the Soviets made use of three sets of tools. The first was the nomogram, " a special graph which reflects the relations between values and makes it possible without additional constructions and calculations, without resorting to other documents and equipment, to quickly calculate and produce the required quantitative data."[49] An example Soviet nomogram can be found in Appendix B. The second tool set was manual spreadsheets the Soviets called "calculation forms." (See Appendix C) During the Cold War, Western intelligence agencies acquired many of the Soviets nomograms and calculation forms. For example, one study produced for the World Class Opposing Force of the U.S. Army's Battle Command Training Program included 237 pages of norms and nomograms.[50] In the final years of the Soviet Union, the military began to make increased use of tactical computers, the third tool. They saw great potential in these computers because of their ability to bring more complex mathematical models to bear on the military decision-making process.[51] It is only reasonable to assume that the militaries of the former-Soviet Union will continue to develop these systems for their own use.

Finally, as a measure of how deeply ingrained their conception of military science was, the Soviets struggled to discover the planning norms of the U.S. Army. The Soviet *Officer's Handbook* includes spatial and temporal parameters for U.S. units down to rifle squad level.[52] As many American staff officers can testify, calculating such figures was surely a vain endeavor. As a leading American scholar of the Red Army noted, "the U.S. has neither a well developed and focused body of military knowledge nor an analytical process that compares with Soviet military science." He lamented that therefore, the U.S., "does not systematically study and critique its past military experience and the past military experiences of other nations."[53] If the leaders of the Army continue to tolerate this situation, then efforts to preserve institutional knowledge of the science of heavy division offensive and defensive operations will likely fail. The Army would profit from adopting certain aspects of the Soviet approach to military science.

As a 1993 British study concluded, their military science provided "a firm foundation on which to base decisions and forecast the battlefield."[54] Commanders of U.S. mechanized forces in the twenty-first-century may sorely miss that ability.

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[1] A. Ya Bayner, *Tactical Calculations*, trans. unknown, Second Edition, revised and supplemented ed. (Moscow: Voyennoye Izadetel'stvo, 1982), 4.
[2] Colonel-General F.F. Gairoronskiy and Colonel M.I. Galkin, *The Advancement of Military Thought,* (Voyenizdat: Moscow, 1991), p244 quoted in C.W. Blandy, "Calculating Combat Outcomes," (Soviet Studies Research Centre, Royal Military Academy Sandhurst, 1993). 9.
[3] For a discussion of the Soviet influence on the development of AirLand battle doctrine see Shimon Naveh, *In Pursuit of Military Excellence: The Evolution of Operational Theory*, ed. Gabriel Gorodetsky, *The Cummings Center Series* (London: Frank Cass, 1997), 272.
[4] William P. Baxter, *The Soviet Way of Warfare* (Novato, CA: Presidio Press, 1986), 4-5. These laws governing the basic nature of war were so important that they were the province of the political leadership of the Soviet Union and not the military.
[5] Adapted from Phillip A. Petersen and Notra Trulock, III, "Soviet Views on the Changing Strategic Context of Military Planning," *The Journal of Soviet Military Studies* 1, no. 4 (1988), figure 1, 452.
[6] *FM 100-2-1 The Soviet Army: Operations and Tactics* (Washington, D.C.: Department of the Army, 1984), 2-1.
[7] Mary E. Glantz, "The Origins and Development of Soviet and Russian Military Doctrine," *The Journal of Slavic Military Studies* 7, no. 3 (1994), 441-444 and Bruce W. Menning, *Bayonets Before Bullets: The Imperial Russian Army, 1861-1914* (Bloomington, IN: Indiana University Press, 1992), 215-216. Czar Nicholas quoted in the same.
[8] Mary E. Glantz, 444,446-447.
[9] James J. Schneider, *The Structure of Strategic Revolution: Total War and the Rise of the Soviet Warfare State* (Novato CA: Presidio, 1994), 2.
[10] Baxter, 12, 18.
[11] Ibid.,, 12.
[12] Mary E. Glantz,, 444,446-447.
[13] Baxter, 18-19.
[14] Schneider, *The Structure of Strategic Revolution*, 116.
[15] C.N. Donnelly, "Soviet Use of Military History for Operational Analysis: Establishing the Parameters of the Concept of Sustainability," (Soviet Studies Research Centre, Royal Military Academy Sandhurst, 1986). 1-2
[16] General-Major S.N. Kozlov, *The Officer's Handbook*, trans. CIS Multilingual Section, Translation Bureau, Secretary of State Department, Canada, *Soviet Military Thought* (Moscow: U.S. Air Force, 1971), 65.
[17] *FM 100-2-1,* 2-1.
[18] Dr. Jacob W. Kipp, "From Foresight to Forecasting: The Russian and Soviet Military Experience," in *STRATECH Studies SS88-1* (College Station, TX: Center for Strategic Technology, The Texas Engineering Experiment Station of the Texas A&M University System, 1988), 19.
[19] Ibid., 42.
[20] V.K. Triandafillov, *The Nature of the Operations of Modern Armies*, ed. David M. Glantz, trans. William A. Burhans, *The Soviet Study of War* (Ilford, UK: Frank Cass, 1994), 165.
[21] Jacob Kipp, foreword to *The Nature of the Operations of Modern Armies*, by V.K. Triandafillov, ed. David M. Glantz, trans. William A. Burhans, *The Soviet Study of War* (Ilford, UK: Frank Cass, 1994), XVIII.
[22] Petersen and Trulock, figure 1, 452.
[23] V. Ye Savkin, *The Basic Principles of Operational Art and Tactics*, trans. U.S. Air Force, *Soviet Military Thought* (Moscow: U.S. Air Force, 1972), 36.
[24] Kozlov, 65.
[25] Donnelly, 15.
[26] Ibid., 17.
[27] Ibid., 15.
[28] Blandy, 13.
[29] Kipp, "From Foresight to Forecasting," 1-2.
[30] Blandy, 12.

[31] Savkin, 114.
[32] Ibid., 113.
[33] Ibid., 119.
[34] Ibid., 121.
[35] Ibid., 52.
[36] Baxter, 92-93.
[37] Anonymous, 24.
[38] Donnelly, 17.
[39] Blandy, 19.
[40] *FM 100-2-1*, 2-11 to 2-12 and Baxter, 94-95.
[41] Donnelly, 6-7.
[42] Dr. Don Madill, Threat Support Directorate, U.S. Army Combined Arms Center, Conversation with the author, 2 November 1999, Fort Leavenworth, Kansas.
[43] *FM 100-2-1*, 2-11 to 2-12.
[44] Savkin,130-131.
[45] Dr. Jacob W. Kipp, "Toward Understanding: A Military -to-Military Conversation on Doctrine, Military Art, and Field Regulations," *The Journal of Slavic Military Studies* 6, no. 1 (January) (1993), 206.
[46] Blandy, 13.
[47] Bayner, 123.
[48] R&D Associates, "Battle Command Training Program (BCTP) Opposing Force (OPFOR) Command and Staff Handbook: Book 2, Chapter 5," (Los Angles: LOGICON, RDA, 1990), 5-3.
[49] Bayner, 22.
[50] R&D Associates. Two this study's principle authors were Afghan Army officers and graduate of the prestigious Frunze Academy.
[51] Bayner, 70. 93, 115.
[52] Kozlov, 231-232.
[53] David M. Glantz, *Soviet Military Operational Art: In Pursuit of Deep Battle*, ed. David M. Glantz, *Soviet Military Theory and Practice* (London: Frank Cass, 1991), 2.
[54] Blandy, 236.

CHAPTER FIVE

CONCLUSION: A WAY AHEAD

In 1984, BG Huba Wass de Czege wrote a landmark article for *Military Review*, describing the process of balancing change and current capabilities in the Army. Among other measures, he argued for the establishment of a more rigorous science of war. Wass de Czege wrote that this process would entail "an active and purposeful effort to develop the branches of knowledge, disseminating what has been learned to others in the field and having those others practice the science, develop it further and then pass on the newfound knowledge to still others."[1] To meet this challenge, he prescribed "a system of institutions designed to sift, organize, and store the body of knowledge, to build a body of theory with this knowledge and to educate practitioners of the discipline."[2]

Sixteen years later, the Army finds itself in a period of revolutionary change still lacking a mature body of military science. In the opinion of one well-placed observer, the Army has neither a coherent nor a rigorous curriculum in military science and lacks the means to qualify instructors to teach its science.[3] This situation is untenable. If the Army is to preserve its institutional expertise in mechanized warfare, it must address this problem. It must undertake to document, analyze, and codify the science of heavy division offensive and defensive operations. Failure to do so would place the Army at risk of being dangerously unprepared for the challenges posed by close combat with peer and near-peer competitors in the new century.

Recent progress outside the maneuver arms suggests a way ahead. Consider the example of the *Chairman of the Joint Chiefs of Staff's Guide to Battle Casualty Rate Patterns for Conventional Ground Forces.* After a rigorous examination of relevant historical experience, analysts concluded that the existing tools for estimating casualties were unscientific and inadequate. These analysts then developed a new approach by applying operations research methodologies to a historically valid database. Though imperfect, the new casualty estimation

tool is vastly improved and it represents a strong step forward in the maturation of American military science.[4]

It would behoove the Army to take a similar approach to division offensive and defensive operations. Such an effort would preserve a usable science, one that would both improve the quality of current planning and facilitate success in future operations. The first challenge facing the Army is collecting relevant experience in heavy division operations. This effort should proceed along two axes. The first is perhaps the most problematic. Department of the Army leadership should order CMH to create a comprehensive historical database on Army combat operations for operational and analytical applications. This implies the systematic mining of official history and archival holdings by Army historians and/or contractors.[5] Such a massive undertaking would be slow and expensive, but the long-term benefits warrant such an effort. The second axis for collecting relevant experience would likely produce quicker results. TRADOC should require its simulation activities and the ORSA community to document the science of division operations imbedded in their simulations and analysis. Since this material already exists in disparate locations, this task amounts to collating and republishing it in a more approachable form. The most critical work would involve recording the science found in the Battle Command Training Program's activities and exercises.

While the lengthy process of collecting the relevant data is still underway, the TRADOC must begin the analysis of that data. Since it is unlikely that this effort will be limited to the heavy force alone, TRADOC should tie proponency for analysis to proponency for doctrine. The Armor School, for example, should analyze data relevant the doctrine to heavy brigades and battalions while the Infantry School focuses on comparable light units. As the proponent for division doctrine, CAC would have responsibility for integrating the work done by the combatant branches.

Before the analysis is too far along, TRADOC will have to establish a system of classification for its products. This author suggests the taxonomy shown below in Figure 5-1. This scheme subdivides temporal factors into tactical task transition factors, march planning

factors, and rates of advance. Tactical task transition factors convey how long a unit requires to transition from one tactical task to another. For example, they might suggest a notional brigade requires two hours to deploy from the march to a formation suitable for crossing its line of departure. March planning factors and rates of advance need no elaboration. Under the heading of spatial factors comes expressions of the battlespace requirements associated with specific units conducting specific tactical tasks. These factors must also allow for at least three levels of tactical density: compressed, optimal, and extended. They must also have values associated with a system of terrain classification such as rolling open, rolling close, urban, desert open, desert close, and mountain.[6] If the brigade in the previous example were operating in rolling terrain and the planners were willing to accept the risk of higher concentration, they might allot it an area fifteen kilometers deep and ten kilometers wide. Finally, the proposed scheme suggests a relative combat power category subdivided into aggregate unit values, weapons system values (for more detailed analysis), and force ratios. Given the difficulties of modeling intangible aspects of combat power, it would be best to limit these factors to tangible and quantifiable variables alone. A simple and adaptable set of digital tools for applying these relative combat power factors must accompany them.

Category	Sub-categories
Temporal	Tactical Task Transition
	March Planning
	Rates of Advance
Spatial	Compressed
	Optimal
	Extended
Relative Combat Power	Aggregate Unit Values
	Weapons System Values
	Force Ratios

Table 5 1 Proposed Taxonomy of Planning Factors

Deciding the optimal terminology for this new science will be equally important. Four terms or phrases have potential application. While a norm is "an authoritative standard," its alternative definition, "a principle of right action binding upon the members of a group and serving to guide, control or regulate proper and acceptable behavior," more accurately represents the word's connotation within the Army.[7] Moreover, the term's association with the perceived dogmatic military science of the former-Soviet Union would make it a poor choice. Another option would be to label the derived science a set of guidelines. This term is more innocuous. A guideline is "an indication or outline ... of policy or conduct," making this term suitable if perhaps a bit weak.[8] Another mild alternative is to call these factors rules of thumb. These are either "a method of procedure based upon experience and common sense" or "a general principle regarded as roughly correct but not intended to be scientifically accurate."[9] This phrase is attractive because its precise meaning falls somewhere between intuition and science, and thus may most accurately convey the nature of the Army's military science.[10] A final option is to use the term "planning factor" as the author has done throughout this monograph. This term has the advantage of already existing in joint doctrine where it means, "a multiplier used in planning to

estimate the amount and type of effort involved in a contemplated operation."[11] While this definition would require some modification, using an established doctrinal term would certainly make this new science more palatable to the field.

The final challenge Army would face in instituting a new scientific approach to the science of division operations is its dissemination to and acceptance by forces in the field. Electronic distribution and CGSC are the key points of leverage. The Army should publish its new planning factors in the form of a Microsoft Access database issued to all CGSC students on CD-ROM. This would likely be the quickest and most cost-effective means for putting planning on a more scientific basis. This format would allow users to run the database on the Army's massive installed base of Windows and Windows CE computers running Microsoft Office applications. Using a widely available consumer database application would also ensure an open architecture. This is important because it would allow end users to customize the file to reflect their unit's peculiar organization, equipment, and experience. It would likewise facilitate the electronic distribution of periodic updates. Once the new planning factors are in the hands of CGSC students, the College must ensure its graduates internalize the scientific approach to planning that they represent. The faculty must modify the curriculum of CGSC to compel students to use the planning factors at every opportunity. Ideally, students would have to demonstrate that every plan they wrote met the standards of executability expressed by the factors. To avoid them becoming dogma, the College should encourage tactics instructors to allow deviations, provided students are able justify them. If CGSC is successful in these efforts, it will convert officers from skeptics to true believers and thereby ensure the viability of the new science of division operations.

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[1] COL Huba Wass de Czege, "How to Change an Army," *Military Review*, November 1984, 39.
[2] Ibid.
[3] Schneider, 492.
[4] *CJCS Guide 3161: CJCS Guide to Battle Casualty Rate Patterns for Conventional Ground Forces*, 15 January, 1998. The chief criticisms of the current methodology are that it only applies to large unit offensive and defensive operations in a major theater of war and requires to much expertise and manual calculations. To realize its full potential, future editions must address the full range of military operations, multiple echelons of command, and come with digital tools to speed and simplify the calculations.

[5] One operations researcher surveyed the holdings of the National Archives in 1970 and concluded that its records were spotty in quality and would require considerable processing before they would be usable. He also found the Army's official histories similarly deficient. See McQuie, 9-13.
[6] The optimal system of terrain classification for this purpose lies beyond the scope of this monograph. Suffice it to say that the a useful system must strike a careful balance between simplicity and fidelity.
[7] *Webster's,* 783.
[8] Ibid., 510.
[9] Ibid., 1012.
[10] An interesting exchange of the definition of rule of thumb occurs in Mearsheimer, 56 with a rejoinder in Joshua M. Epstein, "The 3:1 Rule, the Adaptive Dynamic Model, and the Future of Security Studies," *International Security* 13 (Spring), no. 4 (1989), 97.
[11] *JP 1-02*, 334.

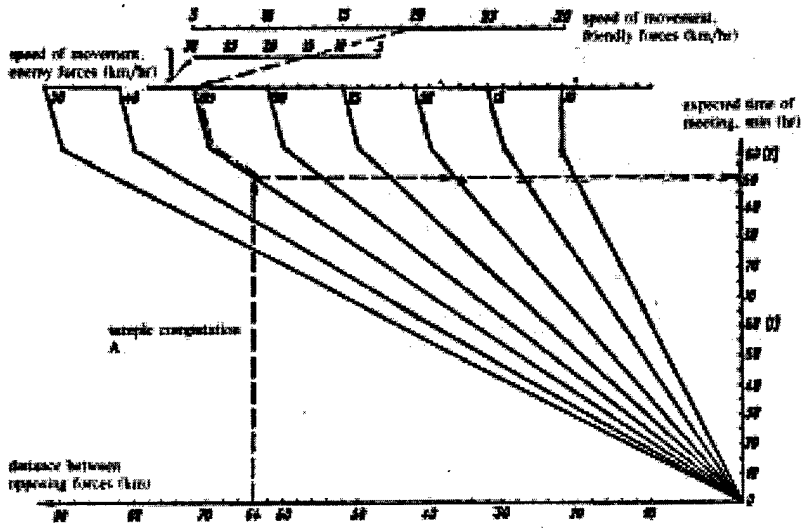
Appendix A: Contents of FM 34-130, Appendix B[i]

Figure	Title	Description
B-1	Mission times	Area of Interest sizes in time, battalion to EAC
B-2	Air areas of interest	Division and corps only.
B-3	Obstacle-crossing capabilities	Dated information about capabilities of selected US and NATO AFVs
B-4	Vehicle characteristics	Dated information about capabilities of selected US and Soviet AFVs. Includes M60A1, M151 jeep and T-62.
B-5	Rating cone index values	For soil analysis
B-6	Terrain types for mechanized or armored forces	Defines parameters for categorizing terrain by degree of restriction
B-7	Cover from flat trajectory weapons	Factors to determine the quality of cover terrain provides
B-8	Concealment from aerial detection and percentage of roof coverage	
B-9	Port categories	
B-10	Height of eye versus horizon range	English measurement only
B-11	Maximum ranges for identification of select targets	Naked eye and 7.8 power magnification only
B-12	Potential obstacles for entry zones	
B-13	Minimum helipad and heliport requirements	By US airframe
B-14	Minimum airfield requirements	By category of lift aircraft
B-15	Degree of slope calculator	Formula for creating one
B-16	Lane widths currently shown on US military maps	
B-17	Typical widths of mobility corridors	Division to company level for generic organizations
B-18	Maximum distance between mobility corridors	
B-19	Load-bearing capacity of fresh water ice	Mostly generic or obsolete US systems
B-20	Extreme battlefield weather conditions	Suggests effects of arctic climate on personnel and equipment
B-21	Desert movement	Day and night speeds for unspecified vehicle movement on three broad categories of desert terrain.
B-22	Average march rates for mixed columns	Generic day, night, and cross-country rates in unspecified formations.
B-23	Average speeds of vehicles	Generic rates on three road categories with three different levels of surface destruction.
B-24	Estimating wind speed	
B-25	Weather effects on courses of action	Evaluates weathers effects on broad categories of operations and units (ex. "Attack," "Commo," and "Airborne" on a range from favors to strongly disfavors.
B-26	Wind-chill factor chart	
B-27	Weather effects critical values	Organized by battlefield operating system and dependant of characteristics of specific and mostly dated systems such as the AN/PVS-5 night vision goggles.
B-28	Obscurant Effects	Dated gross analysis for five categories of sensors
B-29 to B-37	Various tactical planning factors for Soviet-style units and operations	
B-38	Foot marches factor for typical dismounted units	March rates, column lengths, and pass times by number of troops marching.
B-39	Unopposed movement planning speeds for both US and Soviet style units	Simple movement speeds, on and off road, day and night.
B-40	Division opposed rates of advance, in km/day	Extracted from T.N. Dupuy, Numbers, Predictions and War.
B-41	Brigade and below opposed rates of advance, in km/day	Data derived from CACDA Jiffy III Wargame

Figure	Title	Description
B-42	Movement conversion	Rates to minutes to distance conversion table
B-43	Time required for a march unit to pass a single point	
B-44	Length of vehicle march columns	By velocity, interval, and march unit size.
B-45	Typical pass times for tactical road march for US style units	Generic brigade and division factors for the heavy force based on fixed variables. Does not provide sufficient information to assess its applicability to any specific situation.
B-46	Typical defensive frontages for US style units	Platoon to task force. Source and method of calculation unclear. Varies only by "standard" or "extended" frontages. No allowance made for terrain and weather conditions.
B-47	Typical areas of occupation for US style artillery units	Dated information based on older systems.
B-48	Typical number of survivability positions for US style maneuver units	Battalion and company level for heavy units.
B-49	Emplacement time required for US style units	Time required to dig survivability positions for individual weapons systems.
B-50	Typical areas of occupation for US style combat service support units	For nine generic CSS unit types. Does not align well with current CSS doctrine.
B-51	Standard refueling packages for select units within a US style heavy division	Very generic with unclear application.
B-52	Typical planning force ratios	Unexplained and unjustified desirable force ratios suggested for six typical missions: delay, hasty defense, prepared defense, attack on a hasty defense, attack on a prepared defense, and counterattack into a flank
B-53	Calculating force ratios	Text example using weighted unit values.

[i] *FM 34-130*, Appendx B.

Appendix B: Example Nomogram in A. Ya. Bayner's *Tactical Calculations*.[200]



A PROBLEM: Determine the expected time of contact for a meeting engagement between friendly forces advancing at 20 km/hr and enemy forces advancing at 15 km/hr, if the opposing forces are now 64 km apart.

SOLUTION: On speed of movement scales, locate enemy and friendly rates of advance, and read a closing speed of 35 km/hr. Follow the nomogram to the intersection with a vertical line from 64 on the separation scale.

ANSWER: Read a closing time of 1 hr, 50 min off of the meeting time scale.

Figure 4.4. Nomogram for computing the expected time and distance to the probable line of contact with the enemy

Source: A. Ia. Vainer, *Taktícheskie Raschety* (*Tactical Computations*), Moscow: Voenizdat, 1982, p. 45.

Appendix C: Planning Spreadsheets in A. Ya. Bayner's *Tactical Calculations*.[i]

Figure	Title	Description
5.1	March Spreadsheet	Calculates march duration and closure time
5.2	Entry Spreadsheet	Calculates speed of a march unit to it start point
5.3	Passage Spreadsheet	Calculates time required for a march column to move into an assembly area
5.4	Depth Spreadsheet	Calculates the length of a march serial
5.5	Bottle Spreadsheet	Calculates the time required to pass units through a constricted point
5.6	Headtail Spreadsheet	Calculates the pass times within a march serial
5.7	Contact Spreadsheet	Calculates the time and distance to contact with an advancing enemy
5.8	Commander's Time Spreadsheet	Calculates the time available for planning when faced with an advancing enemy
5.9	Pursuit Spreadsheet	Calculates the time or march rate required to overtake an enemy
5.10	Artillery Spreadsheet	Calculates the effects of artillery fire on targets in a given target area
5.11	Rounds Spreadsheet	Calculates artillery ammunition requirements for preparatory fires
5.12	Anti-tank Weapons Effect Spreadsheet	Calculates the number of anti-tank weapons required to reach a specified level of target destruction
5.13	Weapons Spreadsheet	Calculates the probability of mission success for simple and complex weapons system mixtures
5.14	Fire from Position Spreadsheet	Calculates the duration of time a supporting artillery unit can fire from a single position before having to displace forward to support an attack
5.15	Position Change Spreadsheet	Calculates the time an artillery unit will require when displacing
5.16	Radiation Dose Spreadsheet	Calculates the expected radiation dose of units crossing contaminated areas
5.17	Mines Spreadsheet	Calculates the density and coverage of mixed minefields
5.18	Crossing Spreadsheet	Calculates the time required to conduct a river crossing.
5.19	Ford Spreadsheet	Calculates the time required to ford tank units
5.20	Fuel Spreadsheet	Calculates the fuel requirements associated with a march
5.21	Throughput Spreadsheet	Calculates the throughput capacity of a route
5.22	Probability Spreadsheet	Calculates the probability of target detection
5.23	Airborne Crossing Spreadsheet	Calculates the time required to move equipment by aircraft
5.24	Route Spreadsheet	Calculates the march length, march speed, and travel on multiple routes
5.25	Shift Spreadsheet	Calculates the time required to deploy a force from the column into an attack formation
5.26	Rail Spreadsheet	Calculates rail movement times
5.27	Engineer Spreadsheet	Calculates man days and machine hours to complete engineer tasks

Figure	Title	Description
5.28	Planes Spreadsheet	Calculates the number of transport aircraft sorties required to move a given amount of cargo in a given time
5.29	Cargo Spreadsheet	Calculates the amount of time required to move a given amount of cargo with a given number of trucks
5.30	Truck Spreadsheet	Calculates the number of trucks required to move a given amount of cargo in a given time
5.31	Force Spreadsheet	Calculates the sustainment requirements of a force by class of supply
5.32	Region Spreadsheet	Calculates total march time to move from one assembly area to another
5.33	Speed Spreadsheet	Calculates the march speed required to complete a route by a specified time.
5.34	Effects Spreadsheet	Calculates weapons effectiveness
5.35	Reconnaissance Spreadsheet	Calculates the time a reconnaissance system requires to detect a target
5.36	Command Post Spreadsheet	Calculates how long a command post can operate from a given location before displacing

[i] Bayner, *Tactical Calculations*.

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